Editorial

ONCE again Mr. Anthony, the Postmaster General, has clarified Government television policy a little further by his recent statement that Australia's first service may well be a color system, rather than black-and-white.

This does not mean that all transmissions must be in color but rather that, standards, cameras, station equipment and so on would be designed to radiate full color transmissions, where possible. At the other end, the viewer may well have the choice of a simple set which sees everything in monochrome, or a more expensive set-up which reproduces automatically in color or monochrome according to the nature of the programme.

I have, of course, been advocating for some time the most serious re-examination of the television position in the light of the latest overseas developments.

Mr. Anthony may not endear himself to those anxious to see television—any kind of television—commence in Australia, but the hoped-for army of licence-paying public may have cause to thank him for his refusal to be panicked. In a sense, England is now paying the price for her pioneer efforts in the television field. Millions of pounds are tied up in the mediocre 405-line system while other countries, benefiting by her experience and research, are free to adopt more ambitious standards.

In the long run, the radio trade in Australia, as well as the buying public, will reap benefits from a policy of prudence. Its engineers will testify as to the rapidity of technical progress overseas, and I am sure none of them would be happy with precipitate action in the saleman's haste to "get going."

Sir Ernest Fisk, of E.M.I., left Australia with the advice that television should be an ABC monopoly. With this advice I cannot agree. There is no room in Australia for a monopoly in such a vast undertaking, any more than there is for unrestricted trading. To a young country, such as ours, reasonable competition is the breath of life. Quite a few projects associated with the English entertainment world, some of them directly associated with Sir Ernest himself, would benefit by the injection of more competition.

Let us by all means learn from the old world. But at the same time, we must keep pace with the new, if we are to have a part in it.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

Our Front Cover—Although sound asleep, actress Maxine Sheppard is memorising lines for a new show. For full story see page 7.

MODEL SPEEDCARS CLOCK 90 MPH

Our photographer, Ivan Ive, caught these two enthusiasts checking and fuelling their miniature cars for their speed trials. The picture was taken at the 42nd birthday meeting of the Sydney Society of Model Engineers. At their headquarters at Parramatta Road, Ashfield, NSW, the Society conducts special weekly meetings and monthly trials, interests ranging from model steam engines and railways to speedcars and speedboats. Fastest run shown on the board is 92.78 mph, but the club record is held by a Victorian enthusiast whose car clocked better than 103 mph. On the left, Ron Boardman and on the right, Ken Smith.

INGENIOUS COMPUTER PREDICTS

Able Seaman Masson, of the RAN, operates the portable tide predictor. Its comparatively small size is apparent.

No larger than a medium-sized suitcase, an instrument used by the Royal Australian Navy can predict the exact tidal conditions in any part of the world and at any required time. It eliminates hours of tedious calculation and allows the rise and fall of the tide to be read directly off a calibrated dial.

THIS ingenious instrument was one of the secrets wrested from the Germans at the end of the war. Intended to speed up invasion operations, it is now being used as an aid to routine charting and similar operations around the Australian coast.

In all, three "Portable Tide Predicting machines" were captured from the Germans. One has found a home in England, a second is in the United States, while the third is with the Navy Hydrographic Branch in Sydney.

The Germans developed their "pocket-sized" predictor chiefly as an aid to the proposed invasion of the British Isles. Its chief role, therefore, was never filled.

The Allies, of course, had their own computers and predictors which ranged up to a whole room full of precision equipment at the Liverpool Tidal Institute. While such equipment was — and still is — capable of highly accurate readings, it is in no sense "portable." As often as not, commanders in the field had to rely, for their tidal data, on scanty information or lengthy calculations.

The German predictor, on the other hand, could be taken to local positions as required and fitted into the general planning for amphibious operations.

by W. N. Williams

For example, the operational commander may decide that an attack must be launched against a remote point so many minutes before dawn and on a certain date. Reference to the tide predictor may then show that the tidal conditions are unsuitable for landing operations.

How long then, must he wait for the tide to be just right? Alternatively, will the position be better or worse if the operation is delayed by one week?

The operator has only to turn a handle and read off the answer in feet and inches, ebb and flow, as easily as you would read a slide rule.

According to geography books, the rise and fall of the tide is governed

RISE AND FALL OF THE TIDES

by the position of the moon and, this, as a general statement, is undoubtedly correct. However, there are numerous secondary factors which have an important influence and which must be taken into account in accurate calculations.

For example, the mean sea level varies with the seasons, so that the relatively rapid rise and fall of the tide has to be related to variations in mean sea level over a cycle up to twelve months in length.

It is necessary also to consider the variations in average daily and half-daily tides with the distance, declination and orbit of the moon, and the relative position and orbit of the sun.

MANY VARIABLES

Allowances must also be made for the effects of shallow waters in retarding the tides. In some cases the effect can be relatively simple to predict, while, in other areas, it defies ready computation. In all, tidal charts and computations may involve up to forty or fifty constituents which have to be related and solved to produce the single answer required.

Mathematically, the approach is to reduce the numerous variables to cyclic or sinusoidal functions similar to the sine-wave pattern of an alternating electric current. The relative angles, phases, velocities and times are then solved to produce the ultimate answer.

The German portable predictor does this by a series of cranks and pulleys which take into account some thirty-one variables. The general principle is not difficult to follow, although the details of the drive and crank mechanism belong to a remote realm of mathematics.

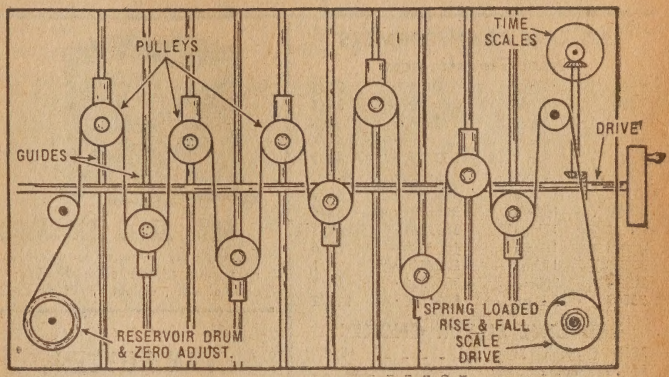
A wire, running from the reservoir drum passes back and forth between a series of free-running pulleys and anchors at the other end around a spring-loaded drum.

ACTION OF PULLEYS

The pulleys are mounted on guides and rails so that they can travel vertically up and down, according to the movement of a series of worms and cranks. The exact amplitude of vertical movement for each drum is governed by the setting of one or more numbered dials on the front panel, each fitted with a vernier scale and magnifying bezel.

When the crank is turned, the pulleys move up and down on their shafts, according to the declination, the radius and the speed of the controlling crank—factors which are governed by the setting of the dials. Some may be moving up while others are moving down. Some move rapidly, others more slowly.

All the time the length of the wire is varying, causing the spring-loaded drum to turn this way and that as it takes up or releases the slack. A scale, driven from the drum, shows the rise and fall of the tide in feet and inches.



Illustrating the basic principles of the predictor. The pulleys move up and down with speeds and amplitudes representing definite periodic-modes. Their total effect on the wire trace is recorded by the motion of the spring-loaded drum.

Simultaneously, another set of scales, driven by the shaft, rolls around to record the passing of hours and days.

By way of demonstration, the operator set up the predictor for the Port of Sydney. With the controls in defined positions, the "zero adjuster" was first set. Then, from tables based on and computed from standard Admiralty tide data, the controls were rotated in a prescribed order and direction to listed settings. After that we could rotate the handle and watch the tide reading lazily rise and fall as the hour scale spun past its window.

The settings would hold for a period of at least 15 days, after which further slight adjustments would normally be made to preserve accuracy of reading.

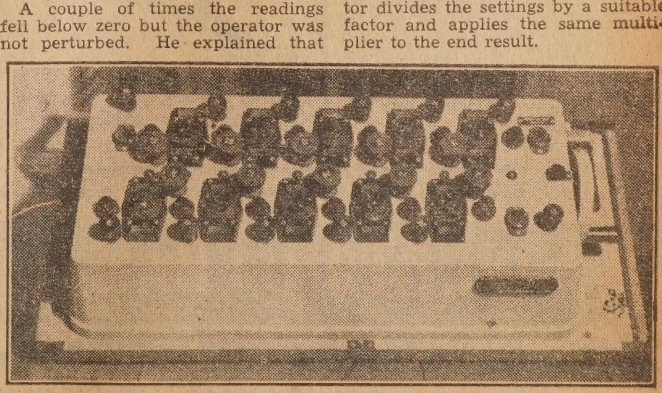
A couple of times the readings fell below zero but the operator was not perturbed. He explained that the tide did fall on occasions below the chart datum.

To predict for any other spot on the globe, the experts first take a complete set of tide pole readings for the nearest port and covering at least one month. If a year's readings are available, so much the better.

From these data, they produce tables for the predictor. Once these tables are prepared, the predictor can thereafter make the necessary adjustments for seasons, times and distances, giving the exact tidal readings with the same assurance as the home port.

SHALLOW WATER

The only major correction which may have to be made is for shallow water constituents of an unduly complicated nature. If the answer looks like running off the scale—and 30 or 40-foot tides are encountered in some parts of the world—the operator divides the settings by a suitable factor and applies the same multiplier to the end result.



A front view of the instrument, showing the numbered controls. Scales, illuminated internally, are visible through small magnifying bezels. Tide readings are visible in the top right corner, while the times scales are below it.

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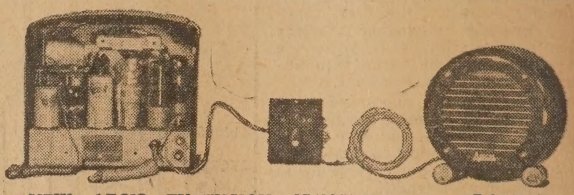

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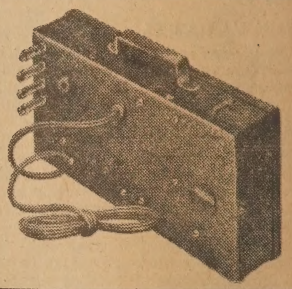

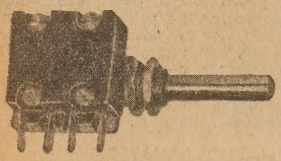

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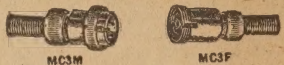
Type S	Door Switch	$\frac{3}{8}$" Neck	4/6



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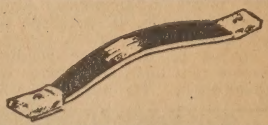

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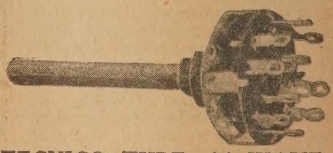

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SLEEP TEACHING WITH RADIO AID

For some time now scientists have known that the brain does not stop working while we sleep. We roll to the edge of the bed, but we don't generally roll out. Some portion of our brain warns us of the danger. We pull up the covers on a cold night. Mothers will sleep through ordinary night noises, but waken instantly when a child cries. In this article, details are given of a new approach to sleep teaching—using the brain's activity during sleep to supplement lessons which occupy us during waking hours.

EXPERIMENTS have been made at the University of North Carolina with an electrical brain wave machine—the electroencephalograph—which shows three basic patterns given off by the brain. These are short, sharp, slightly irregular waves of a high frequency, during deep thought tall, relatively uniform - sized waves, cleanly and evenly spaced during relaxation, and rambling, rounded off waves of no fixed order during sleep.

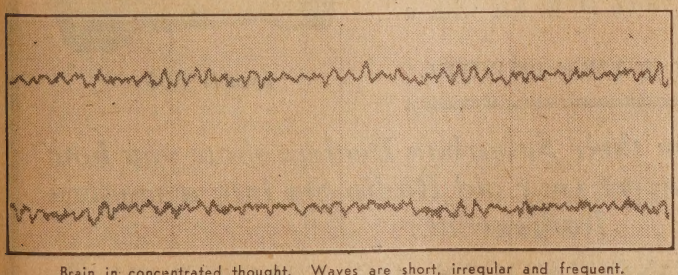
This device allowed the first step to be taken—that of recognising brain behavior during sleep. The next was to devise a method of communicating with the brain in this state without waking the "patient."

Max Sherover, president of the Linguaphone Institute of New York, has applied the gramophone method of teaching languages and other subjects by using a small electric gramophone, clock - controlled, which switches itself on at a convenient time when it can be assumed that the learner is asleep.

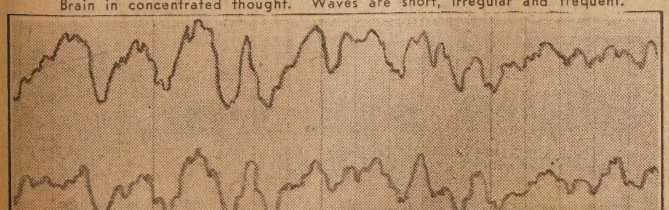
It uses a very small pillow type loud-speaker, which repeats over and over again the matter to be learnt. In an experiment conducted to test the idea, some students were subjected to a verbal barrage of words to be learnt in waking hours. Those so subjected learnt the words much quicker than those who were not.

Other interesting applications of the idea include the cases of singers called upon to sing in languages other than their own. In order to acquire the right accent, their parts were played over to them while they were asleep. In a short space of time the brain apparently accepted the correct accent, in addition to the music itself, and the results quoted showed a definite reduction in the learning period.

Electrodes on man's head connect to electroencephalograph. It measures the brain's electrical waves on graph which is being studied by technician.



Brain in concentrated thought. Waves are short, irregular and frequent.



Brain while person is asleep. Waves ramble lazily but there is activity.

The idea has also been applied in the matter of auto-suggestion. Children were cured of nail-biting by being told when asleep that it was a bad thing to do. Others gained self-confidence through suitable "pep-talks" administered during the night.

The experiments have placed accent on a yet unsolved mystery—why people do fall asleep. Examinations of relaxation, blood pressure, &c., have provided useful data but there are still important links missing in the chain of knowledge.

It is claimed, however, that as the brain apparently never sleeps, there is no ill-effect from trying to use it in this condition.

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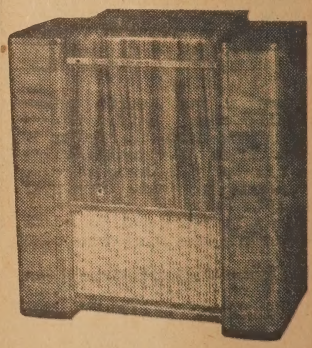

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THE HISTORY OF ELECTRICITY—11

GEORG SIMON OHM AND HIS FAMOUS LAW

Most readers already know all about the famous Law of Electrical Resistance which bears ineradicably the name of that celebrated yet little-known electrical pioneer, Ohm. For Ohm was, indeed, little known during his life time, and his life career has received little notice ever since.

THE truth of the matter is that Georg Ohm lived a very retiring sort of life. He shunned publicity and self advertisement. He seldom realised his ambitions, and fame never came to him.

Indeed, it is a fact that his first announcement of his now famous "Law" cost him his job, for his reasonings set up so much derision against him that, for his own peace of mind, he had to give up his teaching post and, for five or six years at least, to live a life of something like abject penury. There was no honor for prophet Ohm at that time among his own countrymen.

EARLY RECOGNITION

The first body of scientific men to recognise publicly Ohm's claims to scientific eminence was our own Royal Society in London. After the "Copley" medal had been conferred upon Ohm by that Society in 1841 his fortunes began to turn for the better.

The hour of his triumph and of his scientific vindication had arrived. His theories and demonstrations became universally recognised. "Ohm's Law" gradually became an electrical byword in every scientific laboratory the world over.

Georg Simon Ohm came of an old Bavarian family which had been established in the little town of Erlangen for a century or more. He was born in the aforesaid town on March 16th, 1789, the eldest son of a master locksmith who was in business there. His mother died when he was quite young, and the two Ohm sons, Georg and Martin, had, in some ways, to learn how to fend for themselves at an unusually early age.

It happened some years afterwards that a student of a local college was given lodgings by locksmith Ohm, and that, in part-payment of his rent, he undertook to tutor the two sons in arithmetic, geometry, and elementary science. This he did with so much gusto and enthusiasm that the two lads became infected with his love for science. Those early lessons formed the beginning of their careers. Georg, as we know, became, in after life, the pioneer electrician, whilst Martin, his younger brother, grew to be a distinguished mathematician in Berlin.

Even locksmith Ohm, the father of the boys, joined in the family studies, stealing time from his work in order to do so.

It was eventually arranged that Georg should attend the local university to study mathematics, physics and philosophy. This he did, but only for three terms, after which Martin took his place, Georg then obtained a situation as a private tutor in Berne and later in Zurich, Switzerland. Later, however (in

Georg Simon Ohm.

1811) he returned to the University of Erlangen as a student, took his degree there and passed the examination for a position as *privat-Docent* (private tutor) in the university.

Continued want of means compelled him to leave the university and to become a school teacher, specialising in mathematics and physics first in a school at Bamberg and afterwards in the "Gymnasium" at Cologne.

During his period at Bamberg he was very badly paid. Often, to make ends meet, he had to go over to Erlangen to assist his father and to work as a locksmith. About this time he wrote an "Essay on Geometry."

The book was entirely a product of his spare time, and it is said that he wrote it during the cold winter months and in a room without a fire. It would seem, however, that the "Essay" attracted some attention, because it is almost certain that he was subsequently selected for the post at Cologne in consequence of it.

Ohm had a decided gift for teaching, and he was a success at Cologne. But he had higher aspirations than the mere mechanical imparting of knowledge. He began to undertake original investigations, particularly in the realm of electricity.

During the ten active years which he had at Cologne he carried out the electrical investigations on resistance which subsequently made his name famous. But it was all work undertaken against great difficulties. No one was at all interested in his researches.

FUNDAMENTAL WORK

A lone hand, with little time at his disposal, having, perhaps, even less money to expend on his work and having very little apparatus to work with, the persevering and painstaking Ohm plodded away at his experiments week in, week out, during his spare time, at an old work bench in a disused laboratory in the Cologne "Gymnasium."

His fundamental work was given to the world in a series of short papers which were published in obscure German technical journals between the years 1825 and 1827. In the latter year, a formal presentation of his investigations was published in the shape of a pamphlet entitled *Die Galvanische Kette mathematische bearbeitet* (The Galvanic Circuit Mathematically Considered).

Thus was born the nowadays ubiquitous "Ohm's Law," that deservedly famous electrical generalisation which states that the current flowing through a circuit is equal to the voltage divided by the resistance of the circuit and which therefore renders it possible to connect the amperage, voltage and resistance of an electrical system by means of a single mathematical expression.

NOT ENTIRELY NEW

So far as we can gather, Ohm's work on his "Law" was not an entirely new departure solely initiated by himself. We can go back to the days of the Hon. Henry Cavendish

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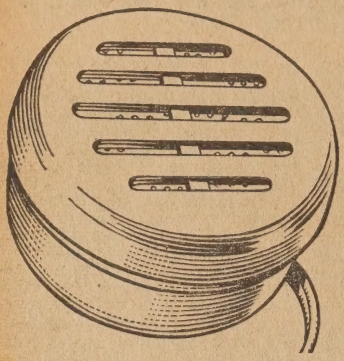

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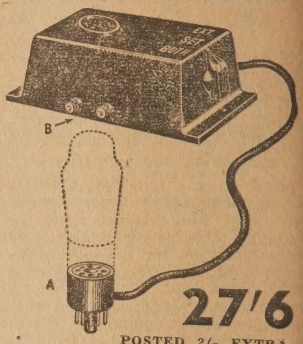

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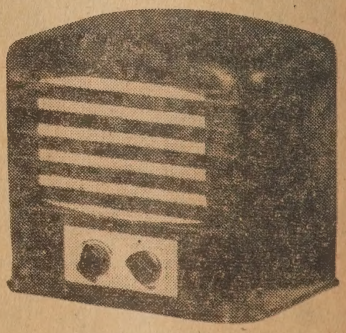

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245 PARRAMATTA ROAD, HABERFIELD..... UA2145

(1731-1810), that strange and eccentric London chemist and electrician who, in his laboratory near Clapham Common, partially anticipated Ohm's great law by showing that the resistance of an electrical conductor is independent of the intensity of an electrical discharge from a condenser.

Indeed, Cavendish went so far as to enunciate laws according to which an electrical discharge divides itself up among a number of conductors.

Very possibly Ohm was quite ignorant of Cavendish's investigations. He seems to have derived his idea from the work of a French physicist named Fourier, who had shown that what he styled the "flux of heat" in a metal bar or rod is directly proportional to the difference in temperature between its ends.

By way of an analogy, Ohm, taking Fourier's cue, experimented with the crudest of apparatus and was able to demonstrate the fact that an electrical current behaves in very much the same way as the "flux of heat," and that, for a given conductor, the "electrical flux" (in other words, the current-flow) is directly proportional to the difference of electrical potential between the ends of the conductor.

Subsequently Ohm showed that, employing exactly the same potential-difference, the current when passed through different conductors is always inversely proportional to the internal resistance of the conductor.

During his early experiments Ohm worked with "galvanic" or chemical batteries. All such articles, however, had the intensely annoying and exasperating property of not maintaining a constant current flow, a fact which Ohm found to render exact work quite impossible.

THERMO-ELECTRIC COUPLE

Fortunately for Ohm, Professor Seebeck, of Berlin, had, in 1821, discovered another source of electrical current when he showed that a current could be generated by heating the junction of two dissimilar metals. Seebeck's device, the thermo-electric couple, proved to be Ohm's salvation in regard to his researches on resistance, for he had in the thermo-battery a current source which was extraordinarily constant so long as the degree of heating was maintained constant.

Ohm used a thermo-battery comprising a bar of pure bismuth which was introduced into a circuit of pure copper wire, one of the two points of contact between the bismuth and the copper being kept below melting ice, the other junction between the metals being immersed in gently boiling water. A simple form of galvanometer was included in the circuit, and it showed readings of the utmost steadiness.

Ohm showed that the resistance of any given conductor to the electric current is directly proportional to its length, and inversely proportional to its cross-section and to its inherent conductivity.

Thus Ohm demonstrated the fact that, unlike the static form of electricity which only resides on the surface of conductors, the ordinary "flowing" electricity which constitutes the current passes equally through the interior of the conductor, for if this were not the case the resistance of a conductor would not be inversely proportional to its cross-section.

OHM'S ENEMIES

Ohm's publication, *The Galvanic Circuit Mathematically Considered*, which appeared in 1827, did not fall entirely on deaf ears. Rather it had to contend with hostile ears.

It is almost incredible that this epoch-making announcement brought its originator misery, distress and actual poverty. The theories embodied in the pamphlet were vigorously criticised, and even derided. They were dealt with in contempt by people who ought to have known better. But the cruellest action of Fate came when the German Minister of Education (who must, obviously, have been influenced by some antagonistic party) gave very pointed hints to the effect that a man who would put forward such theories as were contained in *The Galvanic Circuit* was not fit to be a physicist or to teach science.

In these circumstances Ohm could do little other than resign his teaching post at Cologne. The bitterest disappointment seems to have militated against his endeavoring to defend himself in a positive manner against the assertions of his enemies. His reaction was to throw everything up and to go back to his home town, Erlangen, there to seek refuge from the onslaughts of the scientific world in the high places.

WASTED YEARS

Six good years of Ohm's life were thus wasted at Erlangen. What he did with himself during those years we hardly know. It seems that he continued in some small way his electrical experiments, because a number of papers of minor note written by him were printed in some of the German journals of that period.

His circumstances, which had always been more or less straitened, now degenerated into those of actual poverty. Stung into positive action by the injustice of his circumstances, and impelled also by a condition of life almost approaching that of actual distress, he several times presented his case to the Bavarian king and petitioned a royal review of it. In the end his petitions were heard. He was, in 1833, given a physics teaching post in the Polytechnic School at Nuremberg, a post which led to a professorship and which retained him at Nuremberg for the ensuing 16 years.

(Continued on Page 89.)

NEWS MAN WITH WALKIE-TALKIE

Newspaper reporters used "Walkie Talkies" to cover the recent British elections. This picture shows a candidate chatting with constituents while a newspaper reporter stands by in contact with his office.

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GAS TURBINES FOR FUTURE CARS

PREVIOUS to the new Rover, gas turbine engines had been seen only in large engines where they had demonstrated their simplicity and high efficiency Their application to road transport however, posed many problems, which apparently Rover have been successful in answering.

Essentially the gas turbine operates much like any other turbine, the commonest examples of which are seen in ships driven by steam. The idea of providing the necessary gas flow from internal combustion is really an application of the same scheme, and British rail engineers have already been at least partially successful in using it for locomotives.

A motor car, however, is rather a different proposition, and although Rover are in a position to demonstrate their experimental model, it is unlikely that cars will be available for sale before some years have passed.

Indications are that, although this car is the first to be uncovered from laboratory secrecy, other firms are not far behind in the race, and it seems not unlikely that the gas turbine, or variations of it, will eventually supersede the piston engine in many fields.

As will be seen from our diagram, which shows one method of making such an engine, moving parts have been reduced to a single rotor, a driving turbine, and a gear-box to reduce the high turbine speed to a usable figure.

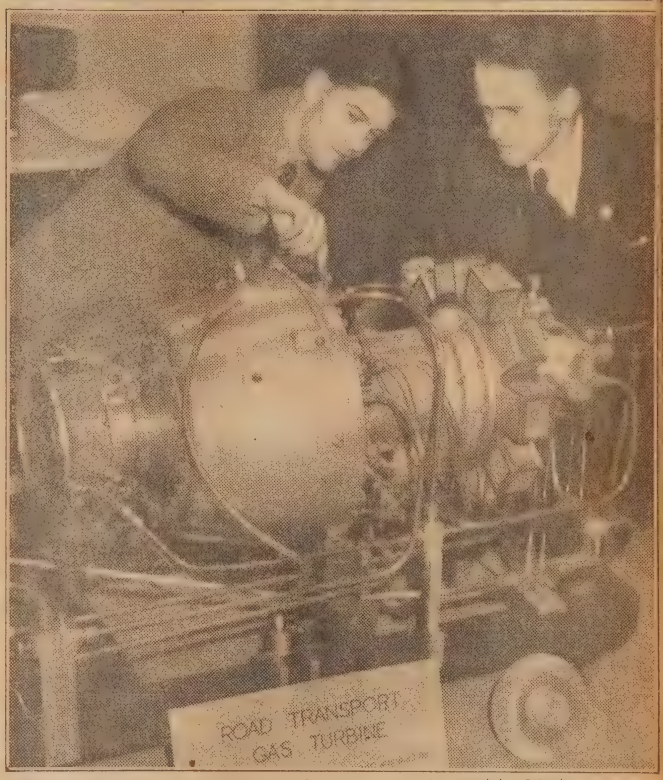
Assuming the motor to be running, air enters through the vent at the front of the engine through the compressor A, into the heat exchanger chamber D, where the compressed air is heated from the exhaust. It then passes into the combustion chamber F where it is mixed with fuel oil injected from the nozzles E and through the first turbine, the function of which is merely to drive the compressor A. It now passes through the driving turbine H, which is coupled to the gearbox J and thence to the transmission.

A convenient method of firing the engine to start would be with a spark plug F when the motor is turned by the starter motor B. Once the engine has started and warmed up, the plug would not be required.

The exhaust is fed back to the heat exchanger chamber where it heats the air ot provide better combustion.

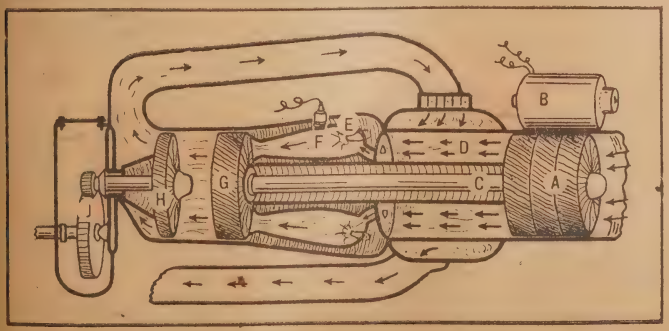
Control of engine performance and speed may be attained by varying the speed of the first turbine, and by the amount of fuel injected into the combustion chamber.

Apart from the enormous reduction in moving parts, it is claimed that the engine will run on almost any type of fuel, from kerosene to candle ends! It is not suggested, however, that the latter will ever become popular in this regard. But it does indicate how accommodating is the design, and points to substantial savings in running costs.



Claimed to be the world's first gas turbine car engine invented by British engineers, this power plant has no pistons, spark plugs, radiator, or clutch. It weighs 250lb and has the equivalent power of a petrol-driven engine of 35-40 hp.

Something like an international sensation greeted the first demonstration by the British Rover car company of a new experimental car driven by a gas turbine engine. It was the climax of many years hard work, and the results obtained were phenomenal. It was claimed to be the first successful vehicle built using a power plant of this type.



A block diagram showing how a gas turbine engine could be made. Details of such engines have not yet been released.

WONDERS OF THE INSECT WORLD

A handful of bees—symbolical of a complex insect society which has fascinated observers for centuries, and which, even today, is not fully understood.

Of all the insects that exist in this world (and there must be billions and billions of different kinds), the common honey bee has probably gained the most attention. This is because of its usefulness as a food provider and the interesting economy which directs its "social" activities.

THE bee has been the subject of much research. School children have become familiar with it, not only in their nature study lessons but also in a practical manner. For not many children have failed to suffer from a nasty sting by being too inquisitive about the movements of a busy bee.

In case any of my readers have ideas of going in for the occupation of an apiarist, the following extract from a recent publication on bees by "Grout" may be of interest. It is headed "How to avoid bee stings."

It says: "If it were not for the fear of being stung, bees would be as common on farms as poultry and many more would be kept in city back yards. Because he is not accustomed to bee stings (just fancy) the beginner at first may fear their effect (note the MAY). The penetration of the sting is always felt, no matter how many years are spent with bees, but the swelling, itching and local fever produced by stings becomes less as time goes on, until the operator actually acquires immunity."

The idea, then, appears to be to get a hive, and then to get stung as many times as possible so as to acquire an immunity!

Nice isn't it? I wish I could acquire immunity from the various species of fellow men who have "stung" me in my life time. I would have been immune years ago.

Recent investigation into the behavior of bees has led to some amazing conclusions.

For centuries, great controversies have raged around the behavior of bees. This still rages more or less but we will leave the arguers and relate a few facts which have come to light in recent years.

BEE STUDY

Many people seem to have plenty of time on their hands to go around peering at bees as they go about their business.

They have tried to find out whether bees collect pollen and nectar on the one trip. They have measured how fast a bee flies (a) with the wind (b) against the wind (c) when there is no wind and so on.

They have weighed the pollen on a bee's legs. They have soaked up the water on a water-carrying bee with blotting paper to find out what quantity of water a bee carries in a day.

The bee has no private life at all with all these sticky-beaks.

One of the most interesting features about a bee is the means it uses to convey information to its work mates.

It has never been proved that bees hear any sounds in a manner similar to a human being. Certain vibrations seem to have some bearing on their behavior. There is also a certain odour omitted by a gland situated in the bee's abdomen which is used to call its hive mates.

It has been noted by many observers for years that when the number of nectar-bearing flowers increases, the number of worker bees or collectors also increases, but decreases when the flowers are no longer blooming.

There is great activity in the hive when, during a shortage of nectar, a worker bee comes home laden with good things.

The interesting point is this. The

FASCINATING LIFE OF THE BEE

bees which rush forth from the hive, returning later with nectar and pollen, do not follow the original bee which brought the glad news. They all clear out on their own. How then did bee number one communicate the location to all the other bees?

INTELLIGENCE

Observers have noted that under such circumstances, bee number one does some kind of a dance when she returns. (All worker bees are females you know, which is as it ought to "bee").

Many ideas have been put forward to account for this dance but the information regarding its meaning is at last made available for amazed inquirers.

The oldest accepted idea was that a pollen-carrier bee did one kind of fox trot and a nectar-carrier performed a barn dance or some such thing. This is not a fact any longer. The kind of dance depends on the distance of the source of food from the hive.

There are two kinds of dances called the "round" dance and the "tail wag dance" respectively.

Here comes a bee now. Food has been pretty scarce of late. The ill disposed farmers round here have ploughed up all their land and left no clover or other flowers. The nurseryman up the road has pruned all the flowers and sold them to the flower shops. A poor old bee can't go into a flower shop. It's simply out of bounds.

What's the news? All the workers rush up to bee now returning from a reconnaissance flight. Men don't rush looking for work like that these days. At least not until their stomachs are empty.

DANCE ROUTINE

Bee is loaded up with nectar. Where did she get it? That's easily told. Bee moves round in a circle then turns around and completes the circle in the other direction. Well, what do you know? The source of food is less than 75 yards away. That's easily found so all workers fly frenziedly in all directions within 75 yards and all come back with loads of nectar.

Just by doing the "round dance" the bee has informed all that the food is to be got within 75 yards of the hive.

But here comes another bee. What's she got to tell? My, my! She has got a load of "tucker." She's been to a party all right? Where'd you get it, sister? Oh you want to dance too, do you?

All the bees watch closely. Sister walks round in a semi-circle. Then she runs straight along the diameter, wagging her tail all the time. She then turns and runs around the other half of the circle and straight up the diameter again. Over 75 yards away, eh? But how much over?

All the bees watch closely. Sister has done about 40 tail wag runs in a minute. That means only a little over 75 yards. Let's go.

If the distance is 2 miles or so sister bee will do only about eight tail wag runs a minute. The farther away the source of supply the less the tail wag runs round the semi-circle.

Should this be the case, of course, no worker is going to search an area of two miles or more diameter sort of haphazardly.

Sister bee knows this but she is up to all the tricks. You want to know the direction, eh? All right. just watch. She arranges her dance to take place on the vertical wall of the hive. She goes round the semi-circle and runs UP the diameter. The food is in the direction of the sun. If she runs DOWN the diameter the bees know that the food lies in a direction away from the sun.

But say the food lies in a direction to the right or left of the sun, what then? 'Seasy. Sister just runs UP the diameter and then to the left or right of the vertical at an angle equal to that by which the food lies to the left or right of the sun.

FLOWER TYPES

One more bit of information sister and we will be off. If we knew what kind of flowers to look for we would find them easily. What are you waiting for then, says sister. Have a sniff. All the bees come forward and smell. My, such expensive perfume, too. Sweet Clover. What a wonderful party you DID have. Well, good-bye. We will all go now. Hope the party's still on.

By such means the bee has communicated her information to the other bees of the hive. The direction, approximate distance from the hive, and the kind of flowers to look for having been given, the other bees have no difficulty in locating the source of supply.

by Calvin Walters

When they return they too perform the dance, thus communicating the information to other bees who may not have happened to be there at the time of the first performance.

So long as the food supply continues to be abundant, the returning bees perform the dance, so that more bees go out in ever increasing numbers.

When the supply begins to run short the dances cease.

Until recent years it had been thought that the work of the hive was apportioned in some mysterious fashion by a "director."

It has now been fairly well established that instinct is the sole guiding hand in this matter and that the work which a bee does in the hive is governed by its age.

During the most active season the life span of a worker bee is from five to six weeks. The first half of this period is occupied with work inside the hive and the latter part is taken up with work in the field gathering pollen or nectar.

From one to three days old the bee cleans herself as she emerges from the cell and then sets about cleaning out the brood cells and laying over the brood to keep it warm.

From the third day to the sixth the bees act as nurses to the eggs and larvae in the cells. They make inspection visits to the cells, supplying food and other care to the larvae within when required. These nurses take food from the other cells (honey and pollen) and feed it to the older larvae.

FIRST FLIGHTS

When the glands which secrete "brood food" function at about the age of five to six days they then solely feed the younger larvae until they (the nurses) are 13 days old.

Often during this period the bees leave the hive for short periods in between jobs and take what are called "orientation flights" around the hive. These flights serve to make the bees familiar with the home and its surroundings.

The first flights are made close to the hive. Later the bees fly a little farther afield.

Comb building is done by bees from about twelve to 18 days old. At this age the wax glands begin to function, and the bees are occupied mainly with this job.

Other jobs required of them at this age are cleaning out the hive and carrying out debris.

At 18 to 20 days old the bee spends all the time guarding the entrance.

From then on the bee goes out collecting nectar and pollen.

Thus it will be seen that the bee automatically carries out the various duties according to age. It would appear that the development of certain glands has something to do with it.

"Cleanliness is next to godliness" is a maxim which the bees practise with considerable agility. From the minute the new bee emerges from

(Continued on Page 23)

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Complete with 6v. Vibrator Supply

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Less Vibrator Supply, £7/7/-

Range, 1470kc. to 10,260kc. In three bands as follows 1470 to 2870, 2800 to 5520 and 5280 to 10,260. Wavemeter operates on:—6 volts A.C. or D.C. L.T. for filament of valve and 90 volts H.T. (no batteries supplied). Valve used 1-6J8

Jack provided for use with headphones when used for checking transmitter.

Circuit diagram, parts list, working instructions, etc. Supplied with each wavemeter.

Weight 23lb. Size 15¼" x 10¼" x 8¼"

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Technical Review

AND NOW—TELEVISION "SIGHT EFFECTS"

Radio has its sound effects and television its "sight effects." This article tells how unusual scenes are produced on a TV receiver screen.

THE directors and producers of television plays and other programmes are finding that TV is much more than an "instantaneous movie." Because pictures are transformed into electrical signals, they can be mixed, faded, and made to produce the most unexpected effects.

That is why the average viewer is no longer surprised—though he may be mystified—when he sees a lissome young lady swimming around in a goldfish bowl. Cleverly controlled electrons are responsible, too, for some of the trick commercials, where the sponsor's name and a picture of his product appear to float above a baseball field.

Squeezing a girl into a goldfish bowl looks like an impossible feat until you take a look at Fig. 1. The diver did her stuff in a giant glass tank while a motion-picture camera took pictures of the act.

At the television studio the film was run off through a projection camera which passed the image to the mixing board. At the same time, another camera was trained on a real goldfish bowl. The control operators superimposed the two pictures so that viewers saw both at once.

At the top of Fig. 1 you see what the viewers saw; a young lady in a bathing suit playing tag with the goldfish!

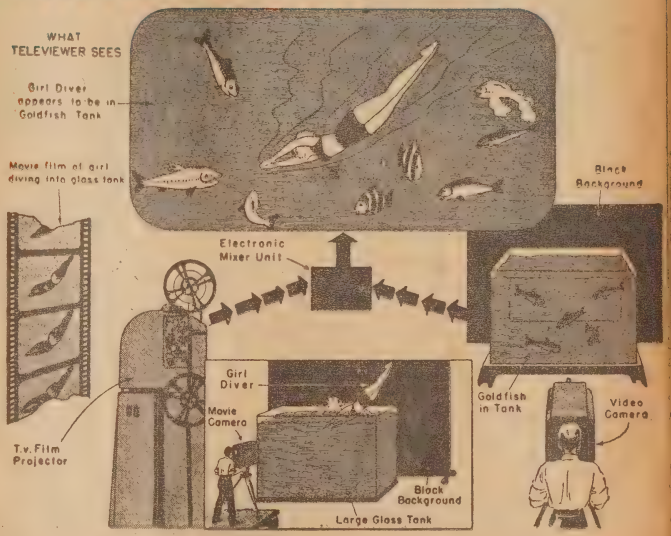

Fig. 1—How movie projector and camera squeeze girl swimmer into fishbowl.

Have you ever sat home on a Saturday afternoon listening to a radio description of a ball game? Time for the commercial announcement comes around, and the announcer begins to tell you about El Ropo cigars.

Right in the middle of his sales talk you hear the crack of a bat in the background and a great roar from the crowd. You're aching to know

Fig. 2—Blurb appears above field.

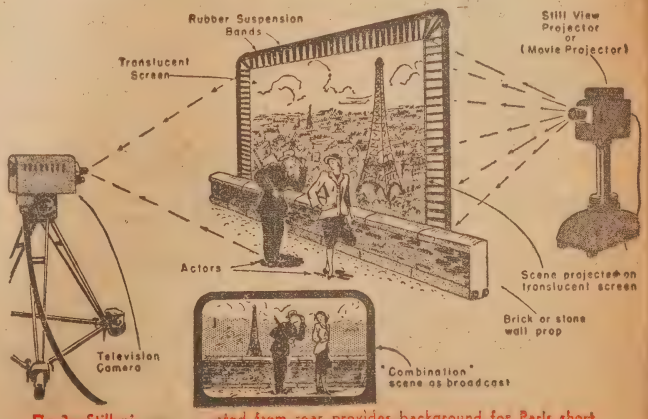

Fig 3—Still [illegible] cted from rear provides background for Paris short.

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D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

PRICE £39/17/6 Plus sales tax.

IMMEDIATE DELIVERY

MODEL 75A

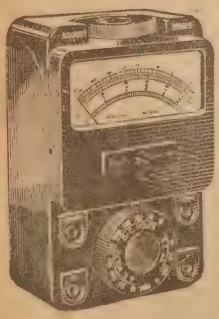
RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0 -1000	0 -1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

PRICE £19/15/- Plus sales tax.

MODEL 120A POCKET MULTIMETER



RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

DIMENSIONS: 4¾" x 3½" x 2"

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Taylor Best for TEST EQUIPMENT

Manufactured by:—TAYLOR ELECTRICAL INSTRUMENTS LTD., GREAT BRITAIN

hat's going on—but you have to ait for the end of the commercial efore you find out.

In television it's different. The aseball game stays right on the reen. But you'll see a picture of ie sponsor's product or a printed essage superimposed on the picture. ften it looks like sky-writing, or as a gigantic transparent frame with awings were suspended over the aying field.

Once again it's the mixers that do (see Fig. 2). One camera picks up ie ball game, and another is aimed a live or pictured advertisement. utputs of the two cameras go to a ixer where just the right amount of gnal from each is sent on to the ansmitter.

EAR SCREEN

Not all television's efforts are pro-uced electronically. For instance, ou may see a pair of actors standing n a Paris roof with the Eiffel Tower oming in the background. To paint backdrop or build a set would cost ore money and take more time than ie scene is worth. But to find a nall picture and use a magic lantern the work of a few minutes.

As Fig. 3 shows, the actors stand on small imitation rooftop with a hite, translucent screen behind em. In back of the scene a still icture projector flashes the Paris iew on the translucent screen. The udience sees the picture as a whole —the actors apparently looking at the ower.

The same technique has been used railroad-train scenes. The action kes place inside the train, but rough the window you can see the lephone poles go by and trees and elds appear in the background. This me a movie projector is used in-ead of a magic lantern.

Pictures taken from a train window re projected on a translucent screen et in the window frame.

At present, only CBS is using rear rojection. The projected scene must e very bright and powerful lamps re used—one, for example, rated at 000 watts. Storm and cloud effects re but one of the myriad possibili-es. The screen is a special one, sing a plastic-type material with ne metallic particles in it.

OG SCENES

One of the most dramatic devices or heightening suspense and tense-ess in a play is thick fog. TV pro-ucers don't wait for a bad night and hoot the scene outdoor; they make ne fog to order. Fig. 4 shows how.

The air in a small box is saturated vith titanium chloride mixed with astor oil. In the bottom of the box s a pan of water cooled with dry ce. When the smoke created by the prayed mixture passes over the cold vater, it becomes very thick and illowy. As it comes out the slot on he other end of the box, a fan irects it to the desired places.

One of the cleverest versions of elevision's puppetry is Du Mont's Magnetoons, produced by J. M. Sei-erth Productions. Small figures slide cross a painted scene, moving arms nd legs and gesturing realistically.

These animated cartoons are perated by small magnets. The fig-

CHEMICALS MAKE REALISTIC FOG

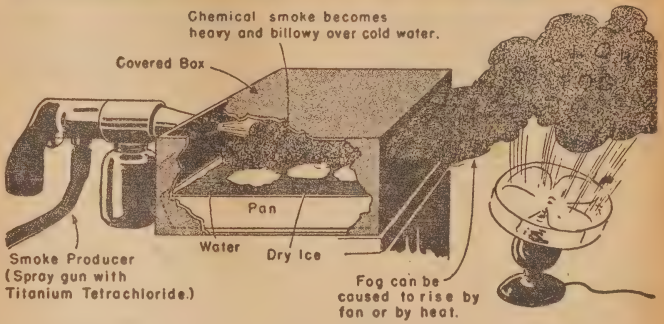

Fig. 4—Spray gun, cooling box, and fan produce a thick billowy fog in studio.

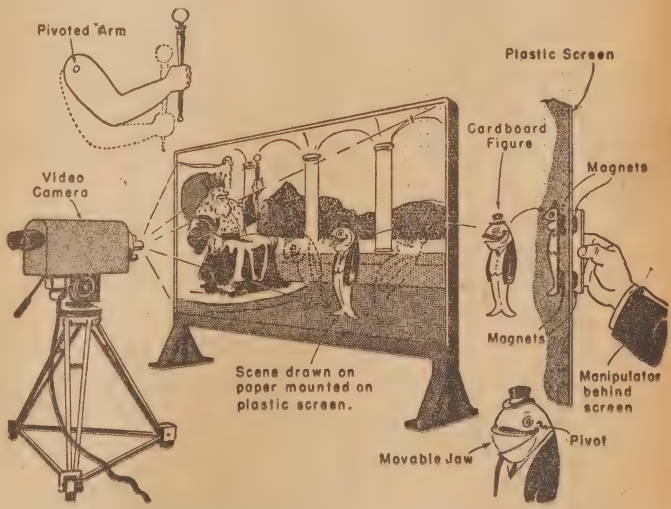

Fig. 5—In Magnetoons productions, cardboard cartoon figures are the actors.

ures are made of cardboard and a magnet is fastened to each of several strategic places. A like-shaped cut-out is against the plastic scenery, behind the figure, and it, too, is fitted with magnets.

Fig. 5 shows how the Magnetoons work. As live actors give voices to the characters, an operator behind the scenes moves the magnets. The figure on the front of the screen follows.

All kinds of startling things happen. Characters appear out of nowhere, balls suddenly drop into sight or disappear. Not only do the characters move around, but jaws open and close as words are spoken and the cardboard actors swing their arms up and down to emphasize their points. To keep perspective as it should be, several cardboard replicas of each figure are used, each in a different size.

Television's heyday is just beginning—but already producers and engineers are outdoing each other in ingenuity. When a little more time has gone by, you may expect to see productions with effects exceeding those possible even in the movies — and with that sense of immediacy which helps to make television programmes more enjoyable than even the best of "canned" entertainn .. (By courtesy of Radio Electronics, US.)

IDENTIFICATION LAMPS, Ex-RAAF

4½ inch diameter Chrome Reflector — black plastic case. Complete with lamp holder of standard car size. Three glasses, clear, amber, and green, supplied with each unit.
PRICE, Each 9/6
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6Y6G	12/6	VR54/EB34	5/-
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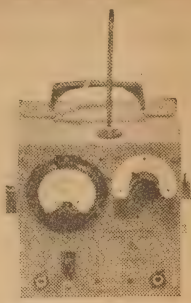

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Please add Postage to above.

FS6 VIBRATOR SUPPLIES

6 volt D.C. input. Filtered H.T. output 290 volts tapped 175 volts at 100 MA. 20 volt bias supply. A.W.A. gas-filled vibrator. Complete in shielded case. Weight packed in original cases 55lbs.
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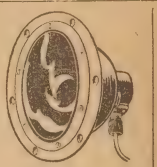
Complete with plugs and cables and spare vibrator.



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Imported
24v. D.C. 1.25 amps. Reversing Connection. Size 2¾" x 2¾" x 1¾". Automatic electric brake for quick stopping.
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Flush mounting — pearl glass — standard car size lamp holder. Ideal roof lights for cars, caravans, launches, etc.
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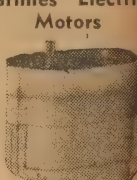

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"SPOT WOBBLE" CUTS OUT TELEVISION LINES

A displeasing feature of a television picture is the presence of the lines which compose it. Moving away from the picture makes them less evident, but many viewers prefer to be fairly close to the screen. A recent issue of "Wireless World" carries an interesting report by R. W. Hallows on a simple means of eliminating the raster pattern.

HAVING heard something of spot-wobble, and finding that it was in regular use in the BBC Research Department, I asked whether one or two friends and myself might be allowed to sample its achievements.

I have to thank Mr. S. N. Watson, of the BBC Designs Department, for his ready co-operation and help. Spot-wobble (which, as its name suggests, means that the receiver scanning spot takes a wobbly, instead of a straight, course across the screen) can hardly be described as new, for the original patent was taken out in 1934 by a French company engaged in the manufacture of gas meters!

Until fairly recently, though, it does not appear to have been exploited; and so far as I know, no use of it has yet been made in any domestic television receiver.

Fig. 1. The scanning spot cannot deal adequately with any element with an area less than its own. Hence, the fine detail of each of the seven tiny areas seen at (a) is lost and all of them appear on the screen as the small uniform medium-grey patch (b). The smaller the spot, due to good focusing, the better the detail brought out.

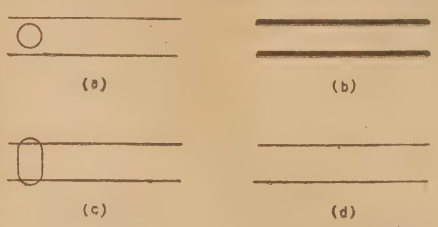

Fig. 2. The unwobbled "round" spot does not (a) quite fill the strip of the image which it scans. The result (b) is that each strip has narrow black borders and the image is "liny". The wobbled spot (c) provides much the same effect as would the actual elongation of an unwobbled round spot, hence (d) the scanned strip is reproduced without the black borders.

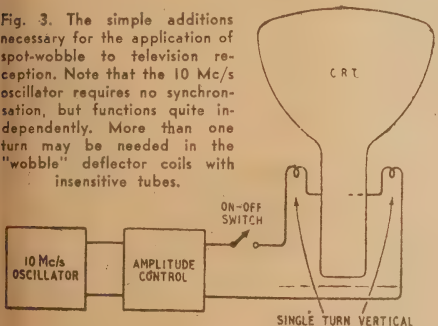

Fig. 3. The simple additions necessary for the application of spot-wobble to television reception. Note that the 10 Mc/s oscillator requires no synchronsation, but functions quite independently. More than one turn may be needed in the "wobble" deflector coils with insensitive tubes.

The instrument used for the demonstration was a receiver, very much of the de luxe order, specially made for the BBC by Cinema-Television Ltd., and containing a 20in c.r.t.

The first surprise was furnished by the position of the chairs in which we were asked to take our places. I did not actually measure the distance between them and the screen, but I am sure that it was not more than seven or eight feet. The reader will know that this is very much less than the optimum viewing distance laid down by the experts for the 17½ x 14in picture shown. The lines should have been very much in evidence; and when the picture first appeared they were.

I was handed a small box connected by a length of twin flex to the receiver. "Cut the spot-wobble in or out as you like," I was told. "It's out now; but do that with the switch and it's in." I promptly did "that." The lines disappeared as completely as if some wizard had removed them with a magic duster.

Handing the box to another of the party I put on my reading glasses, which focus at about 14in and went close up to the screen. Looking right into it in this way one could still see no lines. One was conscious of what I may term a kind of small-scale turbulence of the picture elements, which was somewhat reminiscent of Brownian Movements.

This activity is entirely invisible at over about 3ft to people with ordinary sight. The picture appears clear, detailed and with no dark lines.

So much for the results of spot-wobble. The reader will now want to know just what it is and how it is done. In the familiar system of scanning the screen of the receiver c.r.t. the spot takes a straight-line course from left to right across the screen as it stipples in the image by its varying degrees of brightness from instant to instant.

If we knew how to produce either a square-shaped scanning spot or a perfectly circular spot of unvarying diameter, no dark lines would appear on the screen to annoy us, for the diameter of the spot could be made always equal to the width of a line. Actually, the spot is only roughly circular in shape and its apparent diameter varies in practice quite considerably with the degree of brightness.

BRIGHT CENTRE

On whites the spot has a very bright central portion, though its brilliance tails off towards the sides: it then appears to be larger than when it is dealing with the medium, dark and very dark greys.

The net result of all this is that the average diameter of a properly focused spot is a little less than the width of the slice of the image that it is painting in. At the top and bottom of the scanned line there are two narrow unactivated strips of the screen and, unless one views it at not less than a certain minimum distance, depending on its size, the image shows dark horizontal lines.

The spot-wobble system is so utterly simple that one cannot refrain

(Continued on Page 85)

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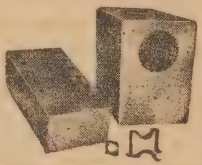
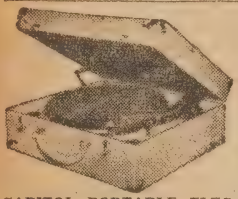
BUILD YOUR OWN DE-LUXE OSCILLOGRAPH. Outstanding Value. The famous 5BP1 Cathode Ray Tube. Originally cost £15. Immediate delivery. Blue print as illustrated to build De Luxe Oscillograph 1/6. Sockets for 5BP1 Tube, each, 9/6.



Cathode Ray Oscillograph Cabinets. Black Crackle Finish Steel Drilled Cabinets and Chassis complete with brackets. As illustrated, 87/6. Power Transformer for 5" Cathode Ray Oscillograph. Price, 99/-.



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The new B.A.1. High Fidelity Crystal Pick-up heads. Suitable to replace all Collaro or Garrard magnetic pick-ups. When ordering advise if required for Garrard or Collaro pick-up. Price, 45/-.

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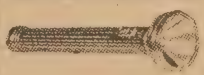

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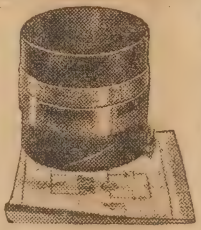

CRYSTAL SET COILS. "Buron" Crystal Set Coils complete with circuit diagram. As illustrated, 4/6.

ALUMINIUM CHASSIS (Undrilled)
As illustrated.

1. 12 x 7 x 2½" Without Ends	8/-
2. 13 x 7 x 2½" With Ends	9/9
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5. 13¼ x 10 x 2½" With Ends	12/3
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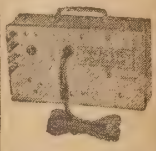
A few more again available. Set builders "Bargain" Foundation kit. Bakelite cabinet chassis. Front mounting plate and dial assembly. Only 45/- complete.

BARGAIN POWER TRANSFORMER. Power Transformer Bargain. Brand new 100Ma. Power Transformer with standard windings. Reduced from 45/1 to 24/11.



THE NEW PORTAPAC. Complete adjustable low and high tension supply to convert any portable battery radio to A.C. operation. As illustrated, £8/12/6.

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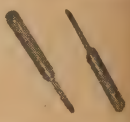
THE NEW CAPITOL EXTENSION SPEAKER. In steel crackle finish cabinet with cord and switch. Colours, cream, grey or black. Price, 45/.-



TEST PROBES. Available in pairs, red and black with chromium insulated brace probes. Per pair, 2/9, as illustrated.

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AUTOMATIC FEED FOR BOILERS

Special provision must be made in order to keep a boiler supplied with water to replace that used in the production of steam and operation of the engine. Two methods are widely used to supply boilers with water—pumps and injectors—while automatic control is maintained by the device illustrated in this diagram-sketch.

OPERATION of the water feed is automatic. The device is designed to maintain water in the boiler at a constant level, and so movements of the essential parts are in fact very slight. In the sketch the movement has been exaggerated for clarity.

The base of the float-chamber (left) is connected by a pipe to the water space of the boiler, while a steam inlet from the boiler leads into the upper part of the chamber. In this way the water level in the float chamber is the same as in the boiler.

FLOAT POSITION

Half submerged in water, the spherical float is normally about halfway up the chamber.

Attached to the top of the float is a rod connecting it to a valve which when open allows steam to pass through the pipe leading across to the cylinder shown on the right.

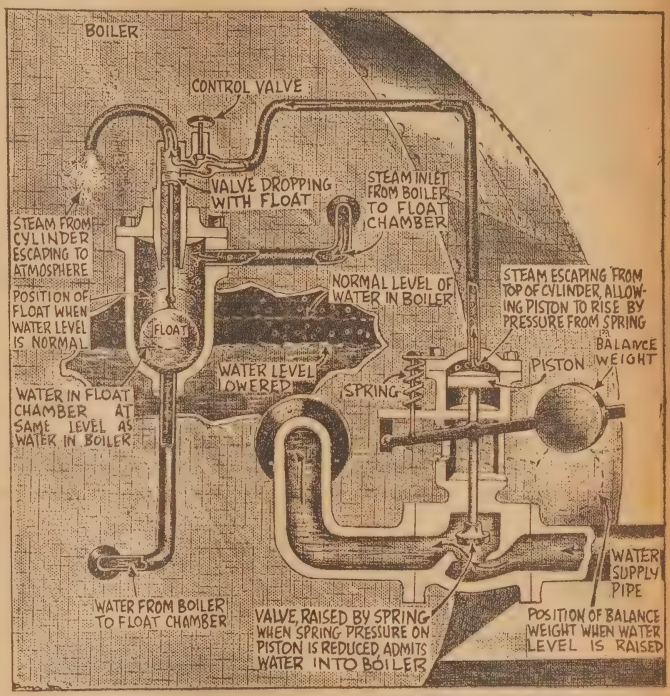
Here the steam forces down the piston. Attached to the piston is a rod and valve which closes the main water supply. Balancing the piston are a spring (to raise the rod and valve) and a counter weight (to lower them).

When the water level in the boiler falls slightly the float falls with it. As shown, this brings down the valve, thus cutting off the steam supply to the cylinder and at the same time opening the pipe leading from the cylinder to the atmosphere.

As the steam escapes from the top of the cylinder the pressure is lowered and the spring comes into operation, raising the piston and the valve which opens the main water supply.

Water enters the boiler and the float now rises.

When the water is at the correct level the valve above the float again opens the way for steam to enter the cylinder, where its pressure forces down the piston and so cuts off the water supply.



INSECT WORLD (Continued from Page 15).

its cell it is actively engaged in giving itself a presentable appearance.

Her legs are equipped with cleaning devices which would do justice to an American gadget company. There are hooks to hook over her antennae. There are bristles to brush the fine body hairs.

The bee spends a large portion of her time in cleaning out the debris from the cell and the inside of the hive.

Ventilating the hive is another important point. When the temperature in the hive is a bit high, the bees use their wings as fans.

The way this ventilation is accomplished is as uncanny as that of the dancing bees.

The bees stand on the board on which they alight at the entrance to the hive. With their heads towards the rear of the hive they fan their wings in such a way as to set up outgoing currents of air through half of the entrance.

When the need for ventilation is very great two batches of fanners may operate. One is stationed near the entrance facing inwards and the other stands just inside the entrance facing in the opposite direction. The combined activities of the bees wings increase the flow of air passing into the hive.

Sometimes in extremely hot weather the bees are unable to ventilate the inside sufficiently to enable the inside to be kept at the right temperature. They will then collect in clusters on the outside walls in an effort to prevent the heat from penetrating to the inside.

It is impossible in such a short space to adequately cover the wonderful activities of this useful insect. Much could be said of the methods of guarding the hive, of the storage of water, of the method of making honey, of the mathematics of the cells of the comb.

Perhaps at some other occasion we will return to this interesting subject and present some more interesting facts.

BELLING LEE *Quality Radio Components*

It is our policy to bring to the amateur and professional radio field in Australia only quality products in which an investment means a financial saving and an insurance of faithful and efficient performance. For this reason we are proud to mention a few of the good things made by Belling & Lee Ltd. They are obtainable from all Eddystone distributors throughout Australia.

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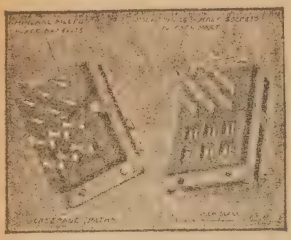


A new range of miniature inter-chassis Connectors, primarily for connecting one chassis or sub-assembly to another. Moulded from mineral-filled bakelite with mild steel surrounds. Each part carries half plugs, half sockets, all silver plated. Non-reversible.

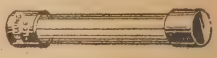
List No. 1 part	Flat Contact	Mould Size
L 610	4-way	1⅛" x 9/16"
L 611	8-way	1¼" x ⅝"
L 612	12-way	1¼" x 1"
L 613	18-way	1⅜" x 1"

Working voltage pin to pin, 1500 volts. Pin to flange, 2250 volts.

PANEL FUSEHOLDERS

L 356 Standard.—To fit fuse behind panel, yet retain accessibility. Bakelite, single hole fixing, bushed from panel, coin slot in carrier. Neat, robust and reliable, with soldier spills. Exceptionally low resistance. With L 1055 1 amp. fuse or as required.

STANDARD FUSE, 1¼" x 1¼"



L 1055 Ratings: 60, 100, 150, 250, 500 and 750 Ma.; 1, 1.5, 2, 3, 5, 10, 15 and 20 amp.

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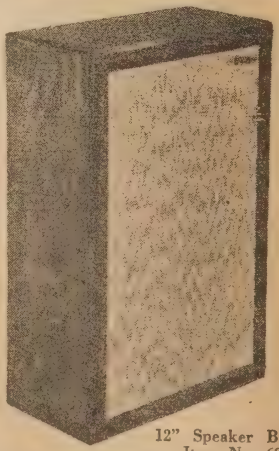
from SPECIALLY DESIGNED SPEAKER BOXES



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NEWS AND VIEWS OF THE MONTH

Television worries

TOP-LINE artists in both Europe and America are apparently worried about the effect of television appearances on their careers, in terms of months and years.

Listeners can hear the same artists for months on end and do not tire of them, provided their material is of the right kind. But when sight is added, it is a very different story. After a few appearances audiences begin to clamor for something new.

Top-line American ventriloquist, Edgar Bergen, is so convinced in this line of thought that he sticks to radio and deliberately avoids television. He stated recently:

"The very thought of being on television once a week is terrifying. It is a terrible drain on all who take part in it.

"Even now, though television is still new, all the big popular shows are searching high and low for new talent. At the present rate of consumption, all available talent will have been consumed within a year. Then where will television turn?

"By that time it will no longer have the appeal of novelty. The thousands who have invested in television will have to be given something. But what?

"Radio, through the experience of years, can supply the answer. Hence, it is my conviction that the radio audiences will flock back to their first love. That's why I am content to remain in radio and stay away from the newer medium."

Local activities

SPEAKING of television, local activities are increasing in no uncertain manner. Again this year, at the Royal Sydney Show, Radio Corporation, in association with the Pye Company, turned on lengthy demonstrations of stage shows and ring events. A special television van is also on the job.

AWA and Philips have taken a different line, with restricted demonstrations to the trade and Government officials, and special emphasis has been laid on the use of television as a teaching aid in hospitals, &c.

During the month the Sydney Museum of Technology and Applied Science instituted a series of public demonstrations and lectures, using still other equipment developed chiefly by Messrs. J. Caldwell, of the Museum staff, and G. Parker, of the Sydney Tech. and the Colville Wireless Equipment Co. It is a simplified 250-line system, but serves to illustrate the workings of full-scale equipment.

Other big firms are doing initial developmental work, but the big question of standards hangs over all such activities. General feeling is that the standards announced by the Chifley Government will be adhered to in principle, but that provision may be made to include possible color transmissions.

RCA in America claim to have the business of electronic color "sewn up" in a system which is completely compatible. In other words, within the framework of normal standards, stations can transmit either in color or black and white, according to the programme material available. At the receiving end, viewers can use either a color or a black and white receiver, according to their purse strings.

While this appears to solve the problem very nicely, the FCC are stalling on the issue for reasons which are not very clear. Actually, they may have little to do with technical feasibility.

The terrific growth of television, its social effects, its enormous demands on ether space and the hundreds of applications for licences are problem

RADIO CROSSWORD PUZZLE, No. 32

ACROSS

6. Places where lines of force enter magnets (2 words).
8. Visual reed indicator (abbr.).
9. Large lecture rooms.
10. Aerial in a building.
11. Transmission units.
13. Oppose alternating current.
15. Anchor points.
16. Draws together.
18. Series feed oscillator (abbr.).
19. Valve with thoriated filament (2 words).

DOWN

1. Current measuring instruments.
2. Point of greatest field strength.
3. Stationary portion.
4. Valve element.
5. Sound recording instruments.
7. Not in.
12. Static disturbance.
14. Promote oscillation.
15. Oil-yielding plant.
17. Ham outfit.

BELOW—LAST MONTH'S SOLUTION

A	T	T	E	N	U	A	T	O	R	S				R
		U		O				E		Y				E
A	E	R	A	D	I	O		R	I	N	G	S		
C		N		O		A	F	S		T		I		
C	O	S	I	N	E	S		T	O	O	L	S		
U			G			T		E		N		T		
M		A	B	A	C		E	D	D	Y		A		
U		S		G		L			A			N		
L	I	T	R	E		A	C	Y	C	L	I	C		
A		A		N	T	M		C		I		E		
T	O	T	E	D		P	L	U	N	G	E	S		
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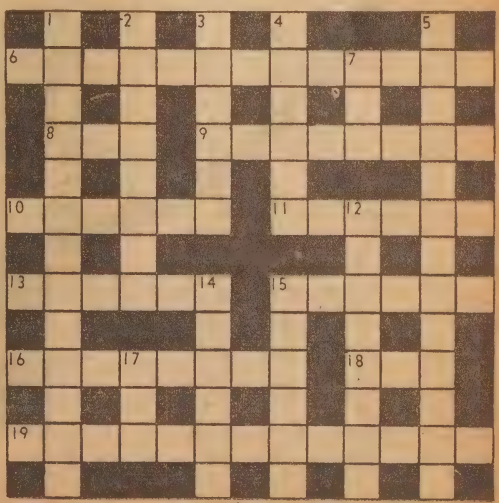


enough, without adding the claims and counterclaims of color systems.

Australia will be in the fortunate position of starting with a clean sheet, with no capital to speak of tied up with equipments and techniques which are partly outmoded.

About amateurs

THIS month, Bill Moore and Ray Simpson have a story to tell about the efforts of amateurs in the recent NSW floods. The resource and energy of those who took part in the emergency networks deserve the highest commendation.

It is indeed a sign of progress to note the increasing awareness of amateurs to the part they can play in such emergencies. Those who live in vulnerable areas should waste no time in getting behind the tentative networks and acquire experience in handling dummy traffic.

A certain amount of battery operated equipment may also have to be built up but, once enthusiasm is awakened, it is possible to get just as much "kick" out of building low-powered gear and making it work as from the big stuff.

But there are a few amateurs—fortunately just a few—who labor under the strange delusion that it is smart to criticise and even interfere with the efforts of their more industrious fellows. There were even instances, during the recent floods, of careless or wanton interference with emergency traffic. Either way the result is the same and it caused one Government official to remark: "A lot of them are just —— nuisances."

The ether is very much public property and the action of a few irresponsibles can go a long way to cancelling the best efforts of amateurs with more sense of responsibility.

Insect wonders

MODERN developments, like radar, are often regarded as something new and completely wonderful.

It is becoming apparent, however, that birds and insects have been using many of these "new" principles from time immemorial. The important difference is that they get results without a rackful of complicated gear!

In an article in the magazine American Scientist, Professor Talbot Waterman says:

"The bees' instrument panel includes a polarised light compass in its eye tissues.

"Bees' eyes have a peculiar sensitivity to polarised light in the sky.

"The bee fixes an image of a distant light source on a specific point in the retina of its eye, then as it flies about it moves so that the image can act as its compass point.

"This arrangement keeps the bee 'on the beam' so long as there is light.

"After dark the bee's compass does not work. Then his path can hardly be called a beeline."

Professor Talbot said the ordinary house fly had antennae which served as airspeed indicators and a "gyroscopic turn indicator."

My Latest Project

Two heads are used with the pickup, one for acetates the other for commercial pressings. To allow the pick-up to track properly it was necessary to mount it with part of its base overhanging the motor board. The pickup is held in position with a small thumb screw so that it can be removed easily, allowing the lid to be fitted for transportation. A piece of fine brass gauze is mounted in front of the speaker to protect the cone from possible damage. Note the strong latches used to fasten the lid to the case and also the twin handles for ease in carrying.

The complete portable recorder, as described. The lid forms the speaker baffle and also carries the various cables, wound on brackets in each corner. Note the amplifier controls and the output level meter on the inset panel. Microphone, brush, discs, &c., are carried separately.

A PORTABLE RECORDER

Setting the style, our Technical Editor described last month the equipment he personally uses for radio and records. In similar vein, Derrick Williamson recounts his experiences in developing a complete portable recorder—his favorite piece of gear. The problems and their solution will be of interest to many readers interested in this branch of the radio art.

by Derrick Williamson

DISC recording has been a hobby for many years and, like most other enthusiasts, I've gone through the stage of building impressive looking amplifiers and turntables, and toiling over home-made cutting heads.

While these efforts have been attended with some success, one can't cut records of church organs, &c., in the home, at least not without arranging for PMG lines and all that goes with them. The obvious alternative was to build something light enough to be carried about and thereby satisfy the demands of many musical friends.

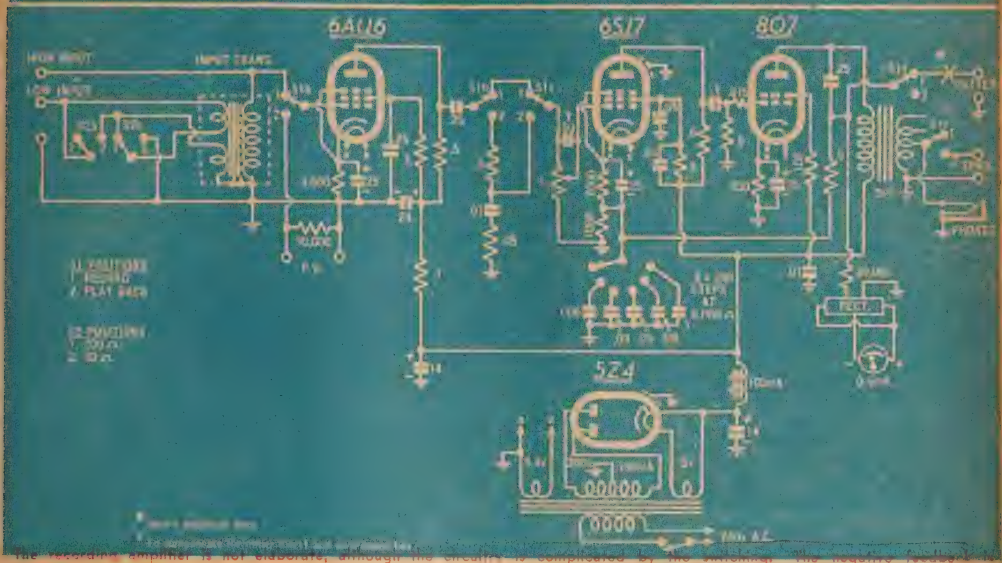
I had no illusions that sheer cost and weight would make some compromises necessary, but I have ultimately turned out discs which are very satisfactory indeed. The quality is comparable with standard pre-war pressings, but with one important difference—there is no background noise.

The final set-up consists of the recorder, amplifier, play-back speaker, microphone and sundry cables in one case, while discs, microscope, swarf brush, hardening fluid, &c., fit into an ordinary suitcase. The large microphone stand, if needed, is carried separately. The case for the recorder measures 16in. x 15in. x 12in. when closed, and the complete equipment weighs approximately 40lb.

One of the first things to decide was whether to make the recording mechanism myself or buy a commercial unit. After a few experiments and a lot of thought, I decided to save up the necessary money and invest in a commercial unit. Home-made recorders are all very well when you can rely on slabs of steel and concrete for stability but, to manufacture a satisfactory portable unit is not so easy, unless you have a fully-equipped home workshop.

The unit finally selected was the Byer R12-D, which is reasonably free from rumble, well constructed and simple to mount and operate. The cutter, mounted in the unit, appeared to be satisfactory However, I

CIRCUIT DIAGRAM OF THE RECORDING AMPLIFIER



The recording amplifier is not elaborate, although the circuitry is complicated by the switching arrangements modified to provide varying degrees of treble pre-emphasis. The input transformer has two primaries which can be connected in parallel or series to accommodate microphones of differing impedance.

decided to use a separate lightweight pick-up and not make the heavily damped cutter perform both operations, as suggested by the manufacturer.

The use of a separate lightweight pick-up greatly increases the useful life from cellulose-nitrate discs due to its higher compliance and low mass. The Goldring Headmaster pick-up was chosen because of its reasonable price and interchangeable heads.

This latter feature enables one head to be set aside entirely for use on direct cut discs, while another head can be substituted when the unit is used to play commercial shellac pressings. Thus the direct cut discs need never be played with a worn needle. The life of the sapphire used for playing these records is almost indefinite and it should never need replacing unless it is chipped through dropping.

WITH MICROPHONE

Anyhow, the recorder was checked over and installed in its case with the amplifier unit to be described below. Initial cuts were made using a high quality dynamic microphone.

Results were quite reasonable on speech although there did appear to be a lack of bass response. On musical programmes, however, the results from both radio tuner and microphone were disappointing. In fact, the discs were very like the early electrical recordings issued in the 1925 to 1930 era.

It was also noticed that the direct recordings which were made with the microphone were of poorer quality than the radio programmes. The blame could not entirely be placed on the "studio" facilities at our disposal, which was a quiet, well-damped lounge room.

I then decided to check the response by cutting a frequency record, and inspect the light pattern formed by the bands of signal on the disc.

This is done by connecting the output of an audio oscillator to the recorder and recording bands of various frequencies. Incidentally, the oscillator used was the one decribed in R&H a short time ago. The output at all frequencies should be substantially constant.

The recording was cut from the inside of the disc, running to the outside to enable me to give full attention to setting the level and altering frequency without having to clear the swarf which comes off the record.

The actual frequencies cut were as follows:—1000 cycles, 50 cycles, 100 cycles, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900, 1000, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10,000 cycles, and 1000 cycles again.

The pattern is inspected by holding the disc obliquely until the pattern shown in the photograph is seen.

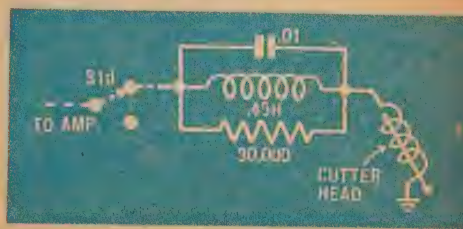
The photographs of the frequency discs were taken in our own photographic studio, using a rather large camera. They could not be duplicated readily by amateur photographers, due to the difficulty of focusing at short distances. However, a photograph is very handy for it allows the light patterns to be studied at leisure.

FREQUENCY CURVES

In point of fact, it is possible to plot approximate frequency curves from photographs by physical measurements of the light band for each recorded frequency. For this purpose, the light, the disc and the camera should ideally be in line and steps taken to minimise distortion due to the depth of field.

The method is not extremely accurate at low frequencies, but it nevertheless provides a reliable guide to the amplitude of the frequencies actually cut on the disc. In my own case, the behavior of the set-up was very clear.

This simple resonant equaliser took the "bump" out of the response curve and is responsible for much improved quality.



R-12-D Recorder and Playback Unit can bring new business right into your shop

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Already many choirs, societies and clubs have purchased R-12-D recorder and playback units. Obviously, there are big sales opportunities in your district to these groups alone. So stock and use R-12-D for a three-way sales dividend.

R-12-D FEATURES: 2 recording and playback speeds . . . 78 and 33⅓ R.P.M. . . . are obtained by simple adjustment. A single head, with excellent frequency response, performs both cutting and playback operations. Ordinary commercial recordings can also be played. Discs may be cut up to twelve inches in diameter. R-12-D is easy to instal, simple to operate. So cash in now on this great new money-making idea. Call your State representative for complete details.

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The light pattern showed a general peak in the response at approximately 2500 cycles and, above this point, the output from the disc fell away at the rate of approximately 12 db per octave. On the low frequency side of the 1000 cycle reference band the pattern tapered by about 2 to 3 db to about 600 cycles and then the 6 db per octave transition from constant velocity to constant amplitude commenced.

Here then was the reason for the disappointing results, a peak in the middle of the range with practically no response above it and a downward taper to the turnover frequency, which itself was too high.

The reproduction from a set-up of this type is satisfactory for speech recording, but poor for musical work, the results sounding very "tubby." This was not at all satisfactory as many of my friends are musicians interested in recordings. One in particular plays a pipe organ having over 2000 pipes, the largest of which produces a 30 cycle note. It was obviously necessary to devise a method for improving the response of the unit.

HIGH OUTPUT VOLTS

One obvious way to equalise the head was to use compensation within the amplifier to give the necessary treble boost above 3000 cycles. The low frequency end could probably be improved by altering the value of the coupling condenser.

In practice, however, this approach is not entirely satisfactory. To obtain the necessary 12 db boost at 5000 cycles, plus another 10 db for radius compensation when recording at 33 1-3 rpm, I would require an amplifier capable of delivering a very high voltage output with little distortion. Although large amplifiers of this type are easy enough to build, they are, nevertheless, much heavier and more bulky than the small job I wished to use. I was not happy either about the effect on harmonic distortion.

The alternative was to use a resonant equaliser, preferably of the double resonance type. These have a certain amount of insertion loss at middle frequencies, but an actual gain at high frequencies. Since the net increase in power required was well within the capabilities of the amplifier, I decided upon this type of equaliser.

TOP LIMIT

With a simple type of cutter head, as used in this particular unit, it is generally not practicable to obtain flat response, beyond about twice the resonant frequency of the armature, if a simple double resonant equaliser is to be used.

This requirement set the upper limit for reasonably flat response at about 6000 cycles. In practice, this has been found adequate for this class of recorder, and is, in fact, as good as most of the commercial records issued up to just before the end of the war.

The equaliser appears to be quite simple from the diagram, but the theory behind the calculation of the values is quite complicated indeed. I can only suggest that you take my word for the values shown. These values are, of course, only suitable for this particular make of cutter, or, at least, cutters with the same impedance and frequency law.

The condenser in the equaliser circuit is selected to resonate with the inductance of the cutter head driving coil at the desired upper frequency limit. This reduces the impedance of the head at these frequencies and allows it to pass more current.

FURTHER STEP

To enable the small condenser to pass the lower frequencies, however, it is necessary to shunt the condenser with an inductance. This reduces the impedance of the condenser at low frequencies allowing the cutter to operate normally.

If we now select this inductance to resonate with the condenser at the armature resonance, we will not only have a low impedance path for the low frequencies, but also a high impedance at the armature resonance. This effectively tunes out the middle frequency peak. The parallel resistor controls the degree of attenuation at the middle frequencies and to a lesser extent the amount of compensation at the higher frequencies.

BETTER RESULTS

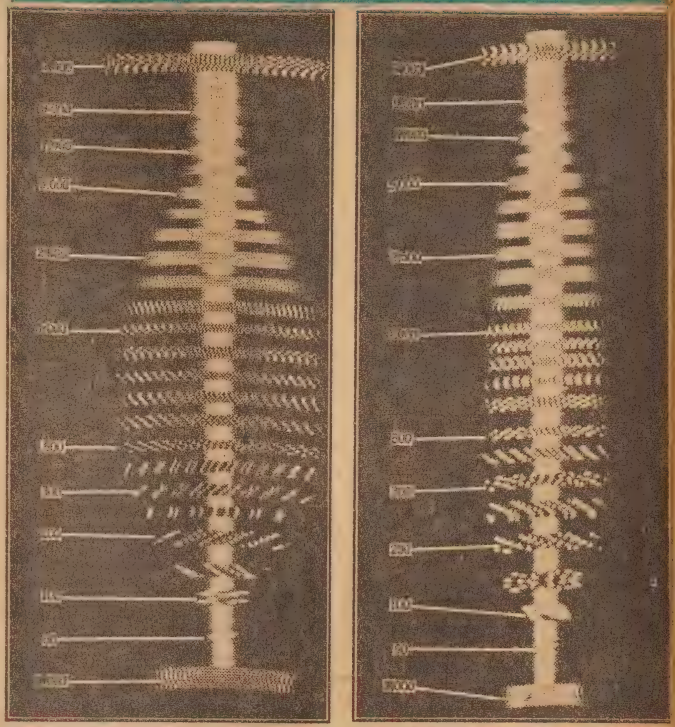
With this equaliser in place, another frequency record was made which proved to be very much better. The peak had been eliminated and the response was now within 3 db to 5000 c/s, with a tapering response above that.

Some of the loss at this end was traced immediately to capacitive losses around the volume control and corrected immediately by adding the 50 pf condenser shown in the circuit. This alone would make the pattern better at the top end and there was the possibility, later, of resonating the cutter circuit a little higher up.

At the bass end, the turnover had obviously slipped down below 200 c/s, indicating a need to reduce the value of the output coupling condenser.

The inductor used in my equaliser was a commercial unit I happened to have on hand. It was modified by stripping off turns until the required inductance of .448 Henry was obtained. I do not know the number

EFFECT OF COMPENSATION



Christmas Tree patterns made with the recorder before (left) and after (right) the equaliser was added. Compensation for capacitive losses in the volume control circuit gave a subsequent further improvement in results.

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12 volt,	550V, 160MA,	**4/10**
12 volt,	345V, 50MA,	**1/10**
12 volt,	275V, 110MA,	**3/10**
24 volt,	250V, 60MA,	**1/10**
24 volt,	300V, 250MA,	**2/5**
24 volt,	350V, 200MA,	**3/10**
24 volt,	550V, 160MA,	**3/10**
32 volt,	275V, 100MA,	**3/10**

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Used tested **7/6.**

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EXCELAIR RADIO

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FOR THE BENEFIT OF DISTANT PATRONS—PHONE ATTENDED TILL 12 PM.

of turns used on this coil, but a suitable coil could be made using the same bobbin as was used in the R. and H. Top Cut Filter units. This could well consist of 4000 turns of 35 B & S enamel wire and would probably be near enough to allow the serious experimenter to get the equaliser into opertaion.

If no means of measuring the inductance is available, then it must be adjusted by trial and error methods. This, I admit, is time consuming and expensive from the disc point of view, but, if no other method is available, it can be used successfully.

TEST CUTS

And now the time had come to once more make some actual recordings of people and instruments.

These first recordings were again made with the dynamic microphone. The recordings of speech were very much better, but there was obviously some lack of bass, even though the pick-up was fully compensated for a 300 cycle turn over frequency. The recordings of musical items were disappointing, too, although they were much better with regard to the high frequency response. In one recording of the pipe organ, the result was just as though the whole of the notes in the low frequency pedal manual were not functioning. This was most disappointing and I must admit that I felt very disheartened by the whole affair.

Having checked and rechecked the amplifier and equaliser and found nothing wrong, I came to the conclusion that the microphone must be faulty. As mentioned before, this was a high quality type which cost a considerable amount of money. It was duly returned to the manufacturers for checking and returned certificated OK.

Subsequent recording, however, still showed the same faults to a greater or lesser extent. The fact that the response did vary somewhat finally led to my determining the exact cause. This proved that the microphone was frequency conscious to a degree, depending upon its distance from the sound source.

OTHER MICROPHONES

A check with the manufacturers brought to light the fact that the microphone was designed to give high fidelity response only when used within seven inches of the sound source—this for close talking conditions or for the "crooner" type of vocalist. Under conditions where the sound source was several feet from the microphone, as was the case with the organ, the response at 50 cycles may drop by as much as 12 db. This meant that although the microphone was excellent for some purposes, such as for use in night clubs or with public address equipment, it was totally inadequate as a recording microphone.

I then carried out experiments with different types of ribbon microphones, both of the cheaper and the very expensive type. In all cases the results were excellent. The main difference between the expensive and the cheaper ribbon microphones appeared to be that the former are more effectively shock mounted, are magnetically shielded and have higher output, due to their larger magnetic systems.

Organ recordings made with this setup were excellent. They have a dynamic range equal to most commercial records. This is due entirely to the very low noise level from lacquer discs cut with a sapphire stylus. The actual recording level is less than that used on commercial discs.

A short technical description of the tuning unit and amplifier used would probably not go astray at this juncture.

The choice of valves for the amplifier was governed entirely by the types on hand and there is no reason why other similar valves should not be used if required. A 6SJ7-GT could probably replace the 6AU6, although the latter was chosen in particular for its higher gain.

When designing an amplifier, I think, it is always wisest to commence with the output stage.

OUTPUT STAGE

Before deciding on the valve and voltages to employ in the output stage it is necessary to calculate the nominal power input required by the head. The insertion loss of the equaliser at 1000 cycles is determined by the d-c resistance of the inductor and the impedance of the parallel connected inductor and condenser.

The power required to drive the head, with my particular equaliser in circuit, is approximately 2 watts at 1000 cycles for full modulation. This power is not high and almost any small output stage would appear to be satisfactory. However, it is necessary to consider the effect of radius equalisation on the power requirements.

If you record only at 78 rpm and with a "straight" frequency characteristic, then a small power output stage will be adequate. However, if you desire to do any recording at the slower speed of 33 1-3 rpm, then it is necessary to allow for a considerable amount of treble boost to enable a reasonably flat groove to be cut throughout the recording.

POWER REQUIRED

The minimum recording diameter at 33 1-3 rpm should be restricted to 7in, and even at this diameter approximately 10 db boost at 5000 cycles is required to keep the output constant. In other words, full modulation with full compensation would require ten times the power.

Theoretically, then, our amplifier should be capable of delivering about 20 watts of power to enable a sine wave with a frequency of 5000 cycles to be cut at full amplitude at a diameter of 7in. However, in practice a much more modest amplifier can be pressed into service, especially where size and weight are important. The point is that the relative amount of energy occurring at 5000 cycles is small compared with that occurring at lower frequencies, and this enables excellent results to be obtained with an amplifier capable of about six watts output. If you are very fussy

Quality Radio Components

COLLARO GRAMO UNITS

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THE NEW COLLARO RC 500 AUTOMATIC RECORD CHANGER has been designed for simplicity and reliability at low cost. The machine will play either nine 10" or nine 12" records, not intermixed.

Any record may be rejected or the machine stopped at any time. Single records may be played.

The RC 500 is fitted with a high-grade crystal pick-up and the arms runs in a twin ball race, ensuring freedom of movement. **£10/7/6**

THE NEW COLLARO AC 504 RIM DRIVE GRAMO UNIT is fitted with a powerful induction motor for 240v A.C. operation. A constant speed of 78 r.p.m. is maintained.

The stop and start is fully automatic. A slight outward movement of the pick-up starts the motor and on completion of the record the motor is automatically switched off.

A good quality magnetic pick-up in moulded bakelite arm is standard equipment **£5/8/-**

The COLLARO AC 501 is similar to the AC 504 but is fitted with a lightweight high fidelity magnetic pick-up in a metal arm. A permanent sapphire tip makes needle changing unnecessary **£7/4/-**

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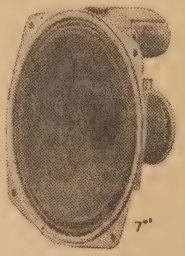


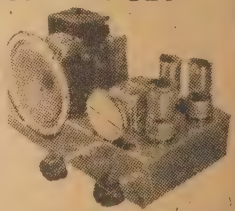
7"

It is the latest type of 5" permagnetic dynamic speaker, as fitted to many commercial portable and mantel radios. A 12,000-ohm transformer is fitted to each, which will match most battery output valves as well as type 6V6GT when operated with 100V on screen **19/9**

Buy now. Bargains like this do not occur often.

POST 2/-.

RADIOMAC "INVERNESS" KIT SET



The "Inverness" is a four-valve kit set for operation from 240 volts A.C. mains. It is a simplified T.R.F. receiver but none of the desirable features of a small radio have been omitted.

The valve types are very modern: 6SK7GT, 6SH7GT, 6V6GT and 6X5GT. A 5" Permag dynamic speaker is supplied.

The complete kit contains all the necessary parts to the last screw and includes a drilled chassis, valves, speaker, cabinet in a variety of colors, and special easy-to-follow instruction sheets.

You cannot go wrong with this kit. The instructions are so clear and our technical staff is at your disposal. **£11/11/-**

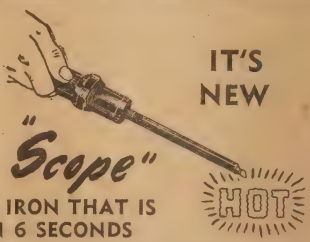
BROWN HEADPHONES

Type "A" (as illustrated). Adjustable reed movement attached to a conical diaphragm of spun aluminium results in the utmost sensitivity, which can be adjusted to suit the particular conditions under which the phones are being used. Ideal for professional use and for the short-wave enthusiast.

£7/5/3

Type "F." A general-purpose headphone that is highly efficient. They are exceptionally strong yet very light in weight. The sensitivity is particularly high, and many years trouble-free service is assured **£2/14/6**

Type "X." Although this model is relatively inexpensive, the results are all that can be desired in a general-purpose headphone. The resistance is 2000 ohms and they can be used on the simple crystal set or small valve set with excellent results. **£1/17/6**



THE IRON THAT IS IN 6 SECONDS

The most revolutionary soldering iron that has ever been offered. It is foolproof, trouble-free and 100 per cent efficient. The SCOPE is ideal for most work, it will cope with small jobs as well as being equal in effectiveness to a 150-watt iron. It operates from 2.5 to 6.3 volts A.C. or D.C. It is thus an ideal adjunct to the tool kit of a car.

SPECIAL SCOPE TRANSFORMER 240/3.8 VOLTS, 30/6. **43/6**

PRICE'S RADIO

5 and 6 ANGEL PLACE - - - SYDNEY

about such things, however, a large amplifier can be used with excellent results.

It was decided to use a single 807 valve in the output stage, as this valve will easily deliver the required output. It is necessary to use a good quality output transformer, with large core. The small types as supplied with loud-speakers are quite inadequate, their small cores saturate easily, and their frequency response is relatively poor.

On the requirements of this power stage alone rests the design of the power supply, as the drain of the voltage amplifier valves is so small that it can be neglected.

EXISTING PARTS

In my particular case both the design of the output stage and the power supply were influenced to a great extent by the parts which I had on hand. These amounted, among other things, to several 807, 6J7-G and 6SJ7 valves, with sundry other amplifying valves, a few odd chokes of various current ratings, a 100 mA and a 150 mA power transformer.

I used the 100 mA transformer together with the 100 mA filter choke The larger 150 mA power transformer was of the vertically mounting type and too large to be mounted in the wooden case. The amplifier built as shown in the circuit diagram will deliver 6 watts of clean sine wave. The HT voltage after the filter choke measures 300 volts, and the total HT current is 82 milliamps.

Heating inside the cabinet is fairly high, and since the photograph was taken I have fitted small metal louvres to the sides and bottom of the case. These louvres allow the air to circulate and keep the interior of the cabinet much cooler.

The voltage amplifier stages have been designed to give the maximum gain obtainable. In both cases the screen resistors are 3 megohms, the plate resistors .5 megohm, and the bias resistors 3000 ohms. This allows a gain of over 200 times to be obtained from the 6SJ7 and a somewhat higher gain from the 6AU6.

FEEDBACK

About 14 db of feedback is applied to the amplifier proper by means of the .5 megohm resistor connected from the plate circuit of the 807 valve to the tapping on the cathode bias resistor of the 6SJ7. Treble boost can be obtained, for radius equalisation, simply by shunting the unbypassed section of this cathode bias resistor with suitable condensers.

More than 10 db of boost at 5000 cycles can be obtained this way. Under "flat" conditions, with no treble boost, the amplifier is flat from 50 to 12,000 cycles within 2 db.

The microphone input transformer is triple Mu-Metal shielded and can be mounted within a few inches of the power transformer with very little hum pickup. An ordinary unshielded or poorly shielded transformer could not be mounted on the chassis so close to the power transformer, but would have to be used

(Continued on Page 43)

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R.C.S. RADIO PTY. LTD.

Radio Components


Filter choke.


Line filter.


Dual-wave units.


Standard 455—K.C. intermediate transformer.


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Speaker transformer replacement coil.


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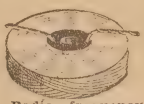
Radio frequency choke.


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Potentiometer.


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Short-wave Coil.

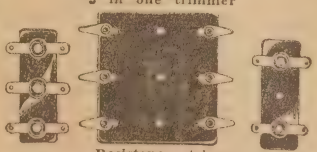

5 band coil.


Voltage divider.

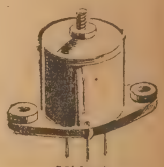

Radio Frequency Choke.


5 in one trimmer


Midget variable condenser.


Resistance strip.


Audio transformer.


Midget Magnasonic Coil

RESISTANCE STRIPS

S7 x 25 12" long, 25 lugs per side	3 6
S8 1" wide—any length per inch	1½d
B1 Anchor Strip	3d

TRANSPOSITION BLOCK

F12 Set of eight	5 6

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IO1 3-8" per 100	2 0 0

SOLDER LUGS

SL3 Single ended per 1000	10 0
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6-PIN COIL PLUGS

1.27 1¼"	1 3
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MO16 2 1-8" long x 1¼" diam.	1 3
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BEAT FREQUENCY OSCILLATOR COILS

Round Can 2¼ x 1 3-8.

F140 455 K.C.	13/-
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R.C.S. RADIO PTY. LTD., 174 CANTERBURY ROAD, CANTERBURY, N.S.W.

PUTTING YOUR C.R.O. TO WORK

IN point of fact, we have run other articles on the subject but confined largely to the mere connection of wires and the interpretation of patterns. The purpose here is to enlarge the approach and consider other factors which have a bearing upon amplifier tests.

The most common use of an oscilloscope in the hands of an amplifier designer is to view waveform patterns as the signal passes on its way through the various stages. The experienced eye can see at a glance the order or gain per stage, the balance between push-pull valves, the onset of distortion—yes, even the likely cause of distortion.

SIGNAL SOURCE

Before any such tests can be made, it is necessary to have a source of audio signal which can be fed into the amplifier under test. Generally speaking, the only source which can be considered for such routine tests is some form of audio oscillator. Gramophone frequency records are invaluable for checking pickup performance and so on, but the duration of the tones is far too short to permit lengthy and close inspection of waveform.

To be of much use, the signal source must be steady, have as pure waveform as possible and be free from hum and noise effects.

One of the audio generators described in past issues of this magazine, or a calibrated beat frequency oscillator represents the ideal, since control is to hand over both frequency and output and the waveform is essentially pure, if the instrument is operating properly.

While there is nothing very involved in the simple generator described only last July and December, it does represent a certain amount of outlay and may be beyond the immediate means of some enthusiasts.

SIMPLE OSCILLATOR

In this case, the next best choice is a simple form of oscillator of the type frequently suggested for Morse code practice. With the aid of an oscillograph, it is usually possible to "fiddle" with the constants and obtain a substantially pure waveform somewhere in the range between 500 and 1000 cycles.

Many of the old-time audio transformers which are pressed into oscillator service produce distorted waveforms much more readily than pure ones, but the desired result can usually be achieved by tuning the secondary with as large a condenser as possible, meanwhile selecting the grid condenser and leak to keep the oscillation frequency up. If, perchance, the inductance is too large to resonate suitably with a large condenser, slipping a few laminations out may do the trick.

There is a special point in providing a signal frequency between 500 and 1000 c/s which, by the way, corresponds to the notes on the piano in the octave above upper C. All routine tests for gain, balance, overload characteristic and power output should be done in this region.

Higher up the range, or lower down, the frequency characteristics of transformers, coupling networks, bypass condensers and so on may become evident and give a false impression of performance.

PERFORMANCE

The correct approach is to check and establish the performance of an amplifier in the middle register and then, as a second step, see how the characteristics are maintained towards the extremes of the range. If a variable frequency audio source is not available, this much has to be taken for granted.

The point about purity of waveform is also important. When the input waveform is pure, at least to the eye, it is not difficult to spot the kind of distortion which is introduced by improper operating conditions in an amplifier. But if one, all the time, has to make mental notes that the input was impure by a certain amount at the beginning, the end result is likely to be complete confusion.

Noticeable distortion in the input signal means, simply, a high content of harmonics. As these pass through an imperfect amplifier, the relative phase of the fundamental and the harmonics may change. At the same time, the harmonics may be reinforced or cancelled by those in the amplifier, leaving the observer the grim task of deciding what really is going on.

Having provided the necessary source of signal, therefore, it can fed into the appropriate circuit the amplifier.

In the case of an ordinary r ceiver or a gramophone amplifi this will normally be from earth the "hot" terminal of the volume co trol. It is generally a good plan connect a coupling condenser series with the "hot" input lead case the volume control is not earth potential for d-c. The volu control can be set to give a suita signal to the first grid for testi purposes.

If, on the other hand, the equi ment under test includes a pream lifier stage, the signal fed to its g should not be more than 100 or millivolts. Too large an input w cause the preamplifier to overlo and distort, irrespective of t setting of the volume control in t following grid circuit.

OVERLOAD

In a case like this, make use the attenuator in an audio generat or provide a subsidiary volume co trol if you are using a more humb set-up. It is not difficult, in a case when a CRO is available see that the waveform from the pla of the preamplifier is not distort by overload.

Having provided the input, t amplifier and speaker will natural emit a loud tone when the contr is advanced for waveform observ tions. Given a set of cast-iron ea drums and a bachelor establishme this may not be any embarrassme Generally, the reverse is tr whether in a laboratory or a hom

To avoid trouble, the usual pl is to break the voice coil circuit silence the speaker and provide resistance load for the amplifier.

The load should naturally be t optimum value for the particular ou put stage but there is the alternati of connecting it in the primary the secondary side of the outp transformer.

For primary loading, the resist is connected normally between t plate of the output valve and B plus, in single-ended amplifier, directly between the two plates f a push-pull system. The value mu equal the rated plate load for t particular output stage.

In the case of a single 6V6-G therefore, the resistance load wou normally be 5000 ohms. For pus pull 807's, it would be 3800, 6600 10,000 ohms, according to the spec fied operating conditions.

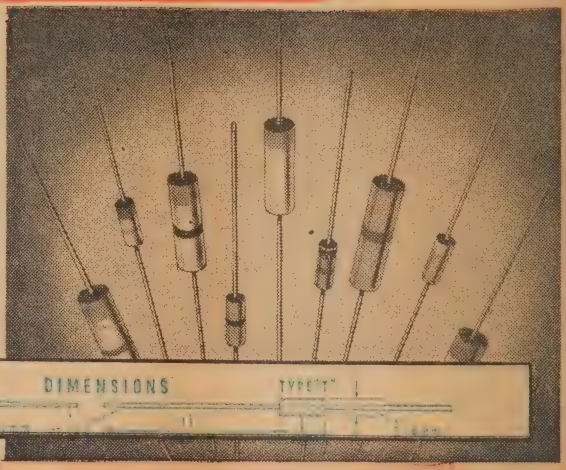
For secondary loading, the resi tor must equal the nominal ir pedance of the voice coil it replace it being assumed that the tran former will reflect the correct in pedance to the primary circuit. R sistors for secondary loading need

> ★
>
> The wave of cheap C.R.O. tubes which hit the Australian market at the end of the war has enabled many readers to build up excellent oscilloscopes, ranging from one-inch modulation checkers to full scale five and six inch laboratory models. This is the first of a series of short articles which link your C.R.O. with a variety of receiver and amplifier tests.
>
> ★

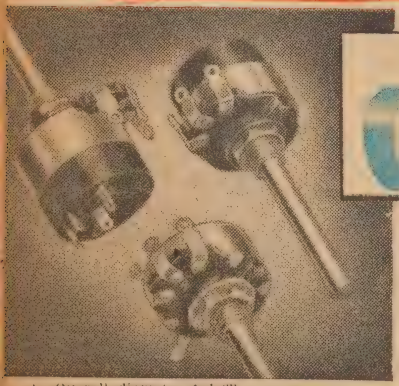
MORGANITE RESISTORS

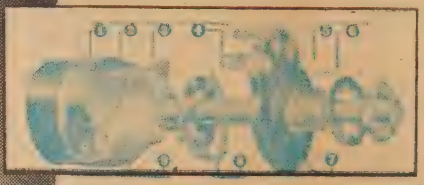
TYPES T and R

These moderately-priced BRITISH Resistors combine high performance with unusually small size. They are made accurately to their stated resistance values and are consistently stable.
The simple construction of Morganite Resistors provides small, robust, light weight components of high power dissipation and low operating temperatures, and are colour coded to RMA Standard.
Stocked in preferred Standard values, viz., 10—12—15—18— etc., values rising in 20 per cent steps (approx.). Morganite Resistors Preferred Value Ranges are standardised in U.S.A. and U.K., and are now available in Australia.



MORGANITE MINIATURE POTENTIOMETERS





New in design .. British made .. and fully incorporates the traditional Morganite standard of quality.
Radio engineers will appreciate not only the small compact size of the Morganite Potentiometer, but the fact that it is available with a single or double pole switch of proved Morganite reliability.

SPECIFICATIONS

1. Overall diameter 1 1-8".
2. Double pole or single pole switch operated from shaft.
3. Pressure diecast rotor and shaft for accuracy and strength.
4. DOUBLE CLENCH TERMINALS eliminate noisy joints.
5. Same track design for switch and non-switch type enables interchangeability. Switch type converted to non-switch by interchanging covers.
6. The renowned MORGANITE RESISTOR TRACK LOW noise, hard wearing, wide range of standard resistance values and gradings. Rating ½ watt.
7. Standard position fixed tapping available.
8. Double prong SPRING CONTACTS, in special non-tarnishing metal for resistor sweep, maintains correct pressure for minimum noise without wear.
9. The switch withstands the most rigorous operating conditions. Rating: 2 amps, 240 volts.
10. Instrument QUALITY at LOW Prices.

THE MORGAN CRUCIBLE CO. (AUSTRALIA) PTY. LTD.
BOURKE ROAD ALEXANDRIA N.S.W.
TELEPHONE MO1311 CABLES & TELEGRAMS "MORGANITE" SYDNEY

have values between about 2 and 15 ohms to substitute for typical speakers.

Irrespective of the position, however, whether in the primary or the secondary circuit, the load resistor must have a wattage rating equal to the amount of power which will be dissipated in them. Thus, a five watt amplifier will deliver five watts into its load, or even a good deal more if the control is turned up past overload point. With big amplifiers, the resistors have to be quite large, if they are not to smoke and burn up.

CHEAP RESISTORS

Amplifier enthusiasts would do well to keep their eyes on some of the dealers' junk counters for oddment high wattage resistors, which often rate no more than a sixpenny ticket. On the surface, few enthusiasts could possibly use 4-ohm 40-watt resistors, yet they are just the thing for secondary loads. Four or five of them, connected in series or parallel, can reproduce any likely value from 1 to 16 ohms. The cost "two bob" and the wattage — at least 40!

The same remarks apply to all kinds of odd values in the higher ranges. Mount them in a box, connect to oddment terminals and you can have lots of ohms and watts for the asking.

Quite apart from removing the din, dummy resistive loads are invariably used in initial laboratory amplifier tests. By measuring the output voltage across known resistance values, it is possible to calculate directly the power output. The amplifier can be tested as a unit and the results compared with those obtained when it is coupled to the reactive and rather uncertain speaker load.

The whole picture should now be complete. The audio signal has been provided and coupled to the input circuit. The amplifier output is being fed into a resistive load and it should only be necessary to clip the C.R.O. earth onto the chassis and run the probe over the various circuits.

STAGE GAIN

The increasing height of the pattern and the shape of the wave should be evidence enough of stage gain and performance. In many cases, it is, but there is one point which warrants special mention—the effect of negative feedback.

In a straight amplifier, with no feedback, the signal passes simply from stage to stage and the onset of distortion can be observed and blamed without hesitation on to the particular stage.

With feedback in operation, the position is not so simple. Let's say that the gain is advanced until, ultimately the output stage overloads badly. One or both peaks are lopped from the wave as a result.

This badly distorted wave is then fed back over one or even two stages in a vain effort to correct the position. If the probe is now placed on the feedback injection point—it may be a grid, a screen, or a cathode, the waveform is observed to be distorted. From the course of our own remarks, we know that the distortion is coming in reality from the output stage, but the newcomer would not be so well informed. He would be left to make up his mind whether the distortion was occurring in the output stage or in any one of the stages inside the feedback loop.

This is not an argument against feedback but rather a reminder of a precaution when testing amplifiers involving it.

CUT OUT FEEDBACK

If in doubt, the course of action is a very simple one—temporarily disconnect the feedback and have a look at the performance without it.

By observing the output waveform, the amplifier can be run up to the point of overload and the output voltage across the load observed, either on the a-c multimeter scales or by the height of the C.R.O. pattern for a given setting of its controls.

There should ideally be no trace of overload in the earlier stages, even when the amplifier is tuned up more to over-drive the output valves quite considerably.

When the feedback is connected again, the gain of the amplifier will drop but it should be possible to get at least as many volts output as before at the point of overload. If not, the feedback is upsetting the performance or imposing too great a demand on one of the earlier stages.

Some careful checking of circuit constants is then indicated and perhaps a re-examination of the basic design.

It is a very simple matter, by the way, to ascertain the gain reduction factor of the feedback while making such tests. With the feedback disconnected, set the amplifier output to a convenient figure, which must not be in the overload region. It may represent 100 volts on the a-c voltmeter or a four-inch pattern on the C.R.O.—the exact figure is unimportant.

Now, without touching anything else, restore the feedback loop and read off the new output. It may be 50 volts or a two-inch pattern representing a 2-to-1 gain reduction or a 6db. of feedback. In practice a gain reduction factor of between 3 and 4 times is generally regarded as optimum.

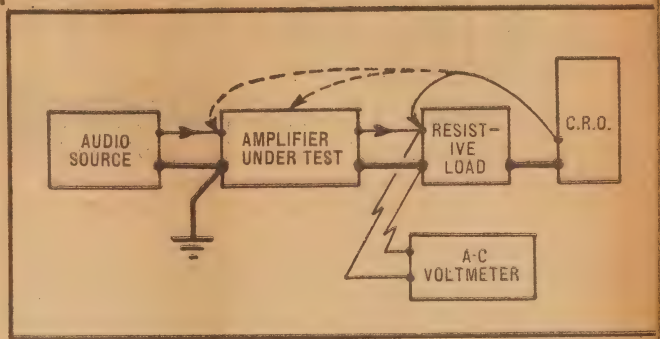
FEEDBACK FACTOR

Insufficient feedback does not "tame" the output valves properly. Too much feedback makes the amplifier insensitive and imposes stringent requirement on the circuit and components to avoid instability troubles.

The figure, of course, can be measured with no more than a audio oscillator and an output meter but the C.R.O. provides a guarantee that the readings are free from overload error. It provides a constant visual check on the conditions which other instruments may be called upon to measure.

However, while this is all very interesting, we are in danger of putting the cart before the proverbial horse. What does a sine wave look like and in what way is it distorted by badly adjusted stages? This and other questions must be the subject of another article.

TESTING AN AUDIO AMPLIFIER



This block schematic illustrates the normal set-up for testing an amplifier. The necessary instruments are available to many experimenters.

Electronic Livestock Scale

AN electronic scale for weighing livestock at public markets, permitting greater accuracy and speed and eliminating nearly all possibility of error or incorrect weights has been developed by the US Department of Agriculture.

The new scale measures the weight of livestock through electrical impulses and records pressures electrically. When certain buttons are pressed, it prints automatically the weight, number, and type of animals, names of the weigher and selling agency, and the date and time of weighing.

A COURSE IN TELEVISION

PART 12 — I.F. AMPLIFIER DESIGN

Having seen, last month, the special requirements for a television broad band I.F. channel, it now remains to see how these requirements are met in practice. This instalment, based on a paper from Aerovox Corporation deals particularly with interstage coupling methods.

N modern radio communication and pulse ranging equipment, e necessity of transmitting and ceiving a large amount of in-lligence per unit time, or of ndling wave forms which con-in high frequency components, pposes difficult requirements on the bandwidth of the cir-its involved.

In the radar system, for instance, modulation of the transmitter very short, rectangular pulses of ergy, results in the R.F. output upying a broad band or spectrum frequencies.

The width in megacycles of the nd required for the transmission such rectangular pulse signals is pressed, to a rough approximation

)

$$\text{ndwidth (mc.)} = \frac{2}{\text{Pulse length (Microseconds)}}$$

Thus, a radar transmitter being dulated by .5 microsecond pulses uld occupy a band (exclusive of nor side bands), of 2 divided .5 4 megacycles.

In television, the transmission of h-definition picture information sisting of several million elements r second, as well as synchronising ses and sound, requires the al-ation of a 6 megacycle channel for ch transmitter in operation.

In any such broad bandwidth tem, if the receiver is to recover much of the transmitted signal possible, it must be capable of ultaneously accepting the entire nd of frequencies transmitted and plifying each equally.

SUPERHETS.

In the super-heterodyne type of eiver, the satisfaction of this re-irement greatly affects the design the I.F. amplifier, since it is this annel of the receiver which deter-nes the over-all selectivity to a ge extent.

Fortunately, the design of broad-nd or "video" intermediate-equency amplifiers has been greatly mplified by wartime research rk. As a result, the design of gh gain amplifiers capable of es-ntially "flat" band-pass character-ics as wide as 10 megacycles is latively uncomplicated.

The bandwidth of an I.F. amplifier taken as the frequency difference tween points 3 db down from maximum amplitude on each side of the response curve and is symbolised by delta f. See Fig. 1.

In the simplest form of amplifier stage, which is the single-tuned circuit shown in Fig. 2, the bandwidth in megacycles is given by:—

(2) $$\text{Bandwidth } (\Delta f) = \frac{1}{2\pi RC}$$

where R equals the total resistance shunting the tuned coil in ohms.

C equals the total capacitance shunting the coil in mmf.

As this relation shows, the bandwidth of a single-tuned stage is inversely proportional to both the shunt

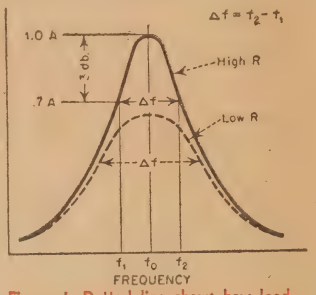


Figure 1. Dotted line shows how loading a tuned circuit lowers the peak and broadens the response.

capacity and the shunt resistance. In practice, it is the resistance which is varied to control the shape of the response curve.

The addition of "loading resistors" across the tuned circuits, common in television and other video I.F. circuits, broadens the response, as is illustrated by the dotted curve in Fig. 1. Loading the resonant circuit lowers the circuit Q and thus reduces the maximum response or gain as is shown.

The bandwidth at the new 3 db point has been increased, but the peak response has been sacrificed proportionately in favor of bandwidth. This demonstrates the important fact that the gain-bandwidth product of such an amplifier is a constant.

This means that a stage giving a gain of 10 over a bandwidth of 1 megacycle may also be made to deliver a gain of 5 at a 2 megacycle band-pass, or any other combination whose gain-bandwidth product G x B) is equal to ten.

The gain-bandwidth product, which is the accepted "figure of merit" of an amplifier stage, depends on the transconductance (gm) of the tube type used and the total distributed shunt capacity in the following manner:

Since the gain-bandwidth product is inversely proportional to C, which includes the distributed wiring capacity as well as the tube interelectrode capacitances appearing across L, it is very important in circuit lay-out to reduce stray capacity to a minimum. In practical circuits using modern tubes, the total C may be limited to 10 mmf.

(3) $$G \times B \text{ (mc.)} = \frac{gm}{2\pi C}$$

Table 1 shows the G x B products for some frequently used tubes, allowing 5 mmf for distributed circuit capacity.

Unfortunately, when single-tuned amplifier stages resonated to the same frequency (synchronously tuned) are cascaded, the overall band-pass does not remain that of the individual stages, but is reduced radically with the number of stages. Four stages each 4 megacycles broad at the 3 db point, when cascaded would thus have an overall band-pass of only 1.75 megacycles.

EXTRA STAGES

This is evident from the fact that, if the voltage gain at the centre frequency (fo) is 19, the gain at the 3 db. points is only 7.07. Upon amplification by a second identical stage, the gain at fo is 10 x 10, or 100, while the gain at the former 3 db points is now only 7.7 x 7.07, or 50, which is 6 db down in voltage. The bandwidth at the 3 db points has been reduced to 64 per cent of that for the single stage.

Further amplification by similar stages would result in the overall bandwidth being reduced to 51 per cent for a third stage, 44 per cent for a fourth stage, 39 per cent for the fifth, &c.

In addition to the undesirable feature of rapidly decreasing pass-band for multiple stages, the synchronously single-tuned system does not satisfy the requirements of the television video I.F. since it is incapable of producing the flat-topped response curve required for picture reproduction. The shape of the video I.F. response which is accepted as the standard in US television practice is shown in Fig. 3.

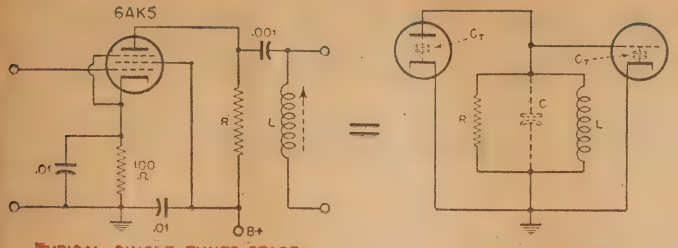


Figure 2. A typical single tuned amplifier stage and its equivalent circuit, used as a basis for the tables and formulae.

An essentially "flat" band-pass of nearly 4 megacycles is required for high-definition picture reproduction on large-screen cathode-ray tubes, although sets using small tubes may get along with much less.

The gradual nearly linear decrease in the response at the picture-carrier end of the curve is intended to compensate for the presence in the transmitted signal of the first 1.25 mc. of the lower side-band. (The rest is suppressed at the transmitter).

When the picture-carrier, I.F., is accurately aligned to the mid-point of this slope, the small portion of the vestigal lower side-band which is under the response curve is compensated for by the omission of a similar area from the lower 1.25 mc. of the upper side-band. Therefore, the response to the lower video frequencies is made nearly equal to the higher ones, although derived partially from both upper and (vestigal) lower transmitted side-bands.

Considerable improvement over the performance of synchronous single-tuned amplifiers may be obtained by the use of multiple-tuned circuits. In a double-tuned, transformer-coupled stage, such as is shown in Fig. 4, the coefficient of coupling (k) and the primary and secondary circuit Q's may be adjusted so that the response curve is essentially flat topped. Such maximally flat or "transitional" coupling occurs when the circuit Q's and the coefficient of coupling are related as shown in Fig. 4.

COUPLING

The term "transitional coupling" is derived from the fact that the coupling is adjusted to the point of transition between the single and double-humped response curve. It will be recalled that, as the coupling coefficient of the tuned transformer is increased from a very small value, the curve of secondary current versus frequency changes from a small sharp peak when the circuits are under-coupled, to a broad double-peaked response when the circuits are over-coupled. (Dotted lines, Fig. 4.)

$$(4) \quad \text{Coefficient of coupling } (k) = \sqrt{1 - \frac{C_o}{C_s}}$$

The coefficient of coupling of the interstage transformer may be determined by measuring the capacity values necessary to resonate the primary to a given frequency when the secondary is alternately open- and short-circuited. (Co and Cs respectively.) Knowing the ratio of these capacities at the value of k corresponding to critical coupling, the transfer of energy to the secondary is maximum and the curve is flat-topped.

The response characteristic obtained in this manner is more nearly that required by the television video I.F. Furthermore, because of the more uniform response over the pass-band, the overall bandwidth does not decrease as rapidly when identical stages are cascaded as in the case of synchronous single-tuned stages. When two double-tuned transitionally-coupled amplifier stages are cascaded, the output bandwidth is reduced to 80 per cent of the width of an individual stage. The corresponding figure for synchronous single-tuned stages is 64 per cent.

Further improvement in gain-bandwidth performance may be obtained by the use of more complicated inter-stage coupling networks. These include: Double-tuned stagg damped, triple-tuned transforme coupled, single-tuned, inverse-fee back and complex filter-coupl stages. Most of these types are dif cult to design and troublesome construct and align, so will not discussed here in detail.

One type of band-pass amplifi which does retain the simplicity design and alignment of the sy chronous single-tuned type, and y overcomes most of its disadvantag exists in the stagger-tuned amp fier. Wallman* and others ha shown that if the successive stag of a simple single-tuned amplifi are adjusted to slightly different fr quencies (staggered) throughout t desired pass-band, the composite r sponse curve may be flat-topp and the gain high.

TUBE TYPE	Trans-conductance (Micromhos)	Tube Capacity +5 mmf.	Gain-Bandwidth Product (Megacycles)
6AC7	9000	21	68.7
6AU6	5200	15.5	53.6
6BA6	4400	15.5	45.3
6AG5	5000	13.3	59.5
6AK5	5000	11.4	69.4

TABLE I

SIMPLE MATHS

Furthermore, the design work r quires only high school maths ar a few simple tables, the constructi done with common tools and t alignment may be accomplished a few minutes with the aid of spot-frequency signal generator an an output meter.

The double-tuned and other mo complex types previously mentione require the use of a swept-frequenc signal generator and an oscilloscop Stagger-tuned systems are bein used extensively in commercial tele vision practice.

Since the individual stages of th stagger-tuned amplifier are merel the single-tuned type shown in Fi 2, the design equations (2) and (3 which were presented in connectio with the synchronously tuned amp lifier may be used. These, used i conjunction with the table of stagger tuning and bandwidth factors show in table II (after Wallman) and method of cutting the coils to reson ance, are all that are needed t complete the design.

To illustrate the method of pro cedure, suppose that a video I.F amplifier using 6AK5 pentodes is t have a uniform gain of 75 db over bandwith of 4 mc. centred at 24 mc

Referring to Table 1, it is seen tha the 6AK5 has a gm of 5000 micro mhos and the total interstage capacity may be limited to 11 mf. The gain bandwidth product (Eq. 3) then be

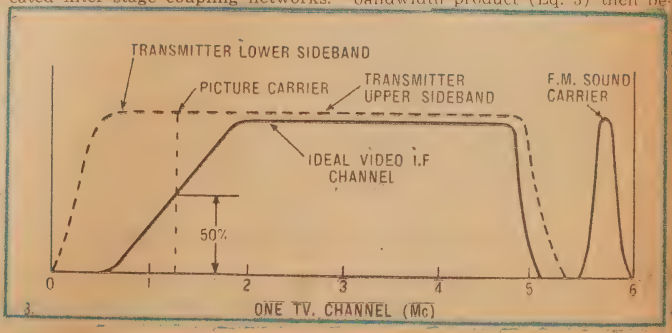


Figure 3. Reprinted from the last issue, this diagram illustrates I.F. channel requirements for US television receivers. Australian requirements will probably be much the same.

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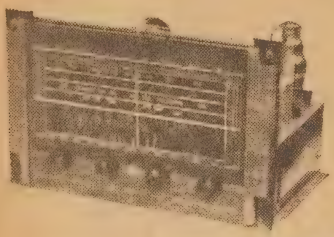

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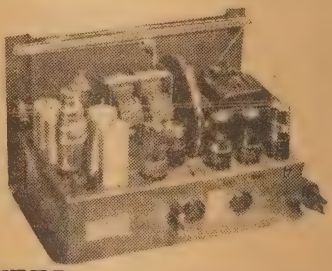

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comes 5000/6.28 x 11 or 72.4 megacycles.

If this stage "figure of merit" is divided by the required overall bandwidth of the amplifier, the result (18.1 or about 25 db) is the mean stage gain available using 6AK5's. Therefore, three stages, properly staggered, should be capable of providing the specified 75 db. gain. Table II gives the value of frequency and bandwidth to which each of the four coupling networks associated with the three stages must be adjusted to form a flat staggered-quadruple.

In this example, the factor d, which is equal to the bandwidth divided by the centre frequency, is 4/24=166. Using this figure in Table II indicates the four circuits should be stagger-tuned to: 24.76, 23.24, 25.84 and 22.16 megacycles with the bandwidths adjusted to: 3.77, 3.56, 1.63, and 1.39 megacycles respectively.

Knowing the required bandwidths and the value of total C per stage, the values of the needed loading resistors may easily be found from the equation for the bandwidth of a single-tuned stage (Eq. 2). Solving for R in this equation yields values of 3845, 4060, 8900 and 10,400 ohms, in the order of decreasing bandwidth.

ACTUAL VALUES

In practice, the next higher standard values of resistance may be used, since other tube and circuit resistances are in parallel with the loading resistors and lower the total effective value somewhat. The inductances required to resonate with 11 mmf. distributed circuit capacitance at the above stagger-frequencies may be determined by the use of a reactance calculator, a "Q-meter" where available, or by empirical formulas.

Since additional capacitance is very detrimental to the gain bandwidth product of the stage, the coils should be self-resonant with the circuit capacity or tuned with high quality powered-iron slugs.

When resistors and inductors corresponding to the values determined for R and L are inserted in typical single-tuned stages such as that shown in Fig. 2, and these stages are connected in cascade, the resulting stagger-tuned amplifier is non-critical to adjust and will compare favorably with more complex types in performance.

• STAGGER-TUNING TABLE •

Δf = Required overall bandwidth, f_0 = Center frequency, $d = \frac{\Delta f}{f_0}$

NUMBER OF CIRCUITS	CIRCUIT FREQUENCY	CIRCUIT BANDWIDTH
Staggered-pair	$f_1 = f_0 + .35\,\Delta f$	$.71\,d\,(f_1)$
	$f_2 = f_0 - .35\,\Delta f$	$.71\,d\,(f_2)$
Staggered-triple	$f_1 = f_0$	Δf
	$f_2 = f_0 + .43\,\Delta f$	$.5\,d\,(f_2)$
	$f_3 = f_0 - .43\,\Delta f$	$.5\,d\,(f_3)$
Staggered-quadruple	$f_1 = f_0 + .46\,\Delta f$	$.38\,d\,(f_1)$
	$f_2 = f_0 - .46\,\Delta f$	$.38\,d\,(f_2)$
	$f_3 = f_0 + .19\,\Delta f$	$.92\,d\,(f_3)$
	$f_4 = f_0 - .19\,\Delta f$	$.92\,d\,(f_4)$
Staggered-quintuple	$f_1 = f_0$	Δf
	$f_2 = f_0 + .29\,\Delta f$	$.81\,d\,(f_2)$
	$f_3 = f_0 - .29\,\Delta f$	$.81\,d\,(f_3)$
	$f_4 = f_0 + .48\,\Delta f$	$.31\,d\,(f_4)$
	$f_5 = f_0 - .48\,\Delta f$	$.31\,d\,(f_5)$

After Wallman

TABLE II

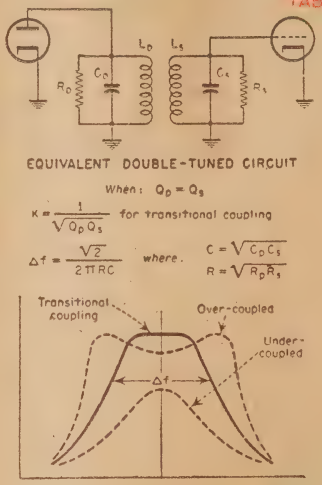


Figure 4. A conventional double-tuned circuit and, below, the effect of varying degrees of coupling on the response.

The overall gain-bandwidth product is better than a synchronous-tuned amplifier of the same number of stages by a factor greater than two. Alignment is accomplished by connecting a standard AM signal generator to the input of the amplifier and an amplitude indicating device such as a voltmeter to the output. The signal generator may then be set to the recommended stagger frequencies in succession and the individual stage corresponding to that frequency peaked for maximum output response.

Due to the isolating action of the tubes, there is virtually no interaction between stages while tuning. This is in sharp contrast to the procedure with double-tuned or triple-tuned circuits. In this case, a swept-frequency signal source and an oscilloscope must usually be connected to the input and output (respectively) of each stage in succession and the coupled circuits tuned and retuned until the desired response is observed on the 'scope.

If adjacent-channel and sound carrier frequency "traps" such as are found in most television video i.f. amplifiers are incorporated in the single-tuned system, some slight tuning interaction may be noted.

*Wallman, Henry. MIT Radiation Lab. Report No. 524.

A COMPLETE PORTABLE RECORDER

(Continued from Page 35)

at least two to three feet from the amplifier and connected to it by a length of shielded cable.

It is not generally realised that high efficiency microphones of the mass-controlled type, that is, velocity microphones, have their frequency response adversely affected by loading the secondary of the input transformer with a resistor. The transformer should be designed to work at the nominal impedances required and then operated unloaded. Under these conditions, not only will the frequency response improve, but the effective output of the microphone will increase by 6 db.

You will notice that the transformer used in the preamplifier is used unloaded. This increase in gain does not apply to dynamic microphones, although the transformer need not be loaded when they are used.

The next point of interest is the switching system which changes from "record" to "playback." This consists of a standard 6 x 2 wave-change switch. I deliberately did not use a switch with sections on each side of the wafer as unwanted coupling can occur.

When in the "record" position this switch connects the input transformer to the preamplifier, the output of the preamplifier to the volume control, the output of the 807 to the cutter, and disconnects the "playback" speaker. The headphones, which are of the low impedance, dynamic type, remain in circuit all the time.

In the "playback" position the pickup is switched to the grid of the preamplifier, the pickup equaliser is connected between the preamplifier and the volume control, the cutter is disconnected and the speaker switched in.

It is most important when wiring the switch to keep the output and input sections of the switch as far apart as possible. If this is not done, violent oscillation is almost certain to occur.

The pickup equaliser does not give the full 6 db per octave equalisation required. The difference is made up by the tone-arm resonance of the pickup, which is approximately 6db at about 50 cycles.

The recording level meter I used is a disposals 0-5 mA movement

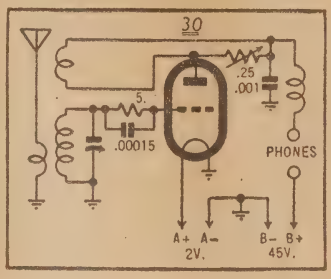
(Continued on Page 89.)

FOR THE JUNIOR EXPERIMENTER

Whatever other shortages may exist, there's certainly no lack of budding designers among our readers. Here are four circuits which come from places situated as far apart as Mackay, Queensland, and Nhill, Victoria. Go through the circuits yourself, first, and see whether you can spot the questionable points we mention in the article.

ACTUALLY the first circuit—a little one valve affair—has no obvious errors and should operate without much trouble. The only unusual feature about it is the method of reaction control, which provides for a potentiometer shunting the reaction winding and thereby limiting its effectiveness. Since one side of the potentiometer is bypassed to earth, and the shaft can be earthed anywhere, there should be no trouble from the hand capacity effects which sometimes ruled out this general type of control.

Whether a value of 0.25 meg. is suitable or not would have to be established by an actual test. The use of an unnecessarily high value would make the reaction control rather sharp in its effect, while too low a value would prevent oscillation being sustained over parts of the tuning range.



This one-valve circuit should operate first try, although an adjustment to the reaction control may smooth out its operation.

DIFFERENT VALUES

The idea, therefore, would be to try progressively lower values until a value is discovered which allows plenty of regeneration under all conditions, yet is sufficiently smooth in operation.

The .001 bypass is quite usual when the valve is feeding into phones but, when a detector is feeding into a high impedance audio transformer, as for a two or three valve set, a large condenser will lead to unnecessary loss of treble response. In this case, a lower value, say .00025 mfd., would be a better choice.

In this circuit, also, the RF choke could probably be omitted without any effect on the performance. It is external to the reaction circuit and its only possible value would be to help keep RF out of the audio stages, should these be added at a later date.

The two valve battery circuit comes from the same Victorian reader and there isn't much wrong with it either — just two or three points which warrant mention.

There is actually no need for the .05 meg. resistor to the screen of the 1P5-GT. This valve is designed to operate with up to 110 volts applied directly and reduction of the screen voltage cuts the stage gain. True, economy has to be considered in some cases, but the current drain with only 45 volts on plate and screen would be so low that further reductions would not appear to be justified.

Our advice, therefore, is to omit the screen resistor altogether and allow the present screen bypass to serve also as a bypass on the H.T. line.

If, for any reason, the screen resistor is retained, it may be wise to wire a 0.1 mfd condenser from B+ plus to earth in the interests of stability. This condenser is not always necessary, but it is a good general precaution in all receivers having RF or IF stages in addition to the detector.

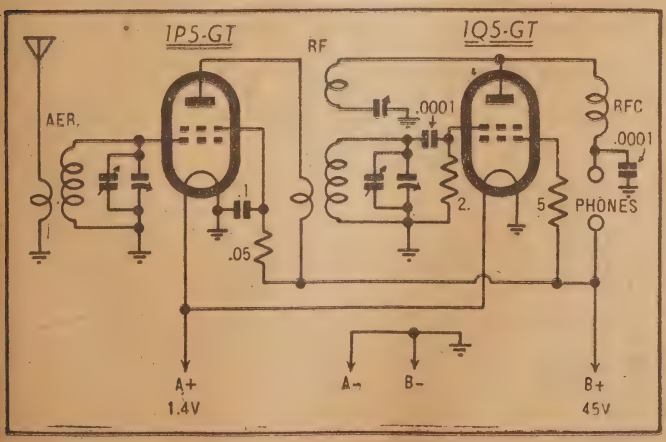
THE DETECTOR

Coming to the detector, the use of a 1Q5-GT is unusual but quite legitimate if there happens to be one on hand. The only possible criticism in this set is that the filament current is higher than other 1.4 volt types. The total difference between 100 and 150 milliamps is not great, however.

The signal is shown apparently fed to the screen but we can only assume that this is a drawing error—and how easy they are to make! There would be no point at all in reversing the function of the grids.

As it is, what is apparently intended as the screen is fed through a 0.5 meg. resistor, without bypass. This is definitely wrong practice.

Some dropping resistor is necessary in the screen circuit to limit the plate current of the 1Q5-GT, which is not really designed to operate in a zero-biased detector service. The plate current with only 45 applied would not be damaging but it would probably be higher than necessary. A series screen resistor could be used to cut down to a milliamp or so and our guess would be a value of about 50,000 ohms. Half a meg. sounds too high altogether and may even prevent the valve from oscillating reliably.



This two valve circuit contains a definite error. Can you find it? We also have something to say about the operating conditions of the R.F. amplifier.

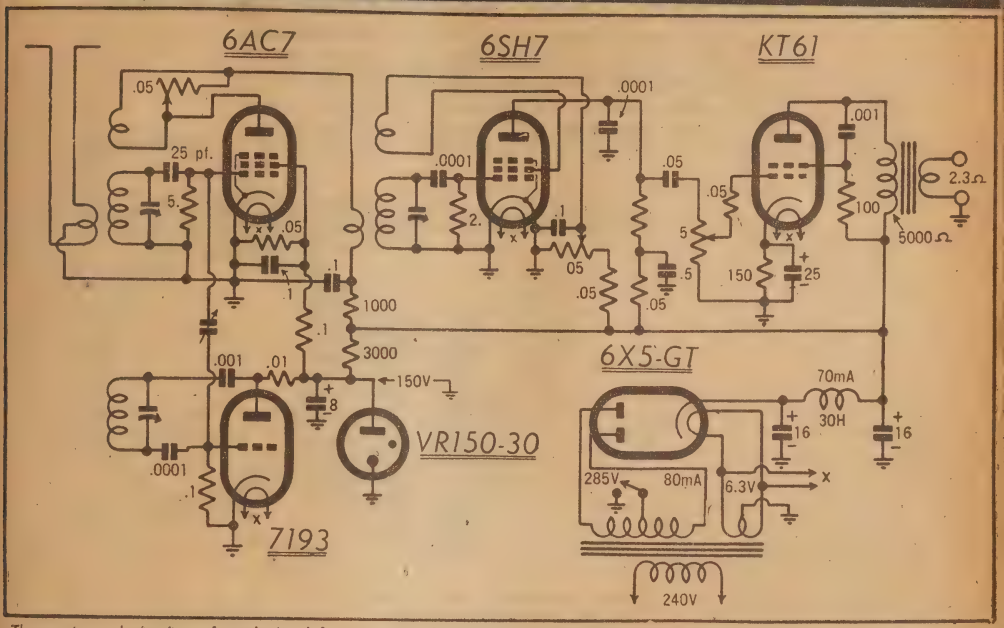
SCREEN BYPASS

However, irrespective of the value of resistor, the screen should be bypassed to earth. A 0.1 mfd. tubular would do or, better still, a low voltage miniature 0.25 mfd. type.

The two valve a-c circuit, this time from a NSW reader, must come in for its share of criticism.

All is well up to the detector grid but, in the plate and cathode circuits, the budding designer has gone astray. First of all, the detector cathode should go straight to earth, this being a zero-biased grid-leak de-

NOVEL SUPERHET HAS TUNABLE I.F. CHANNEL



The most novel circuit so far submitted for comment, this set has plug-in coils and a tunable I.F. channel for bandspreading. A tricky one to get going, it would nevertheless be an interesting one for the more advanced experimenter.

tector. Likewise the cathode end of the screen potentiometer should be earthed, so that the 0.1 mfd. bypass at this point is redundant. In fact, if this condenser is changed into an earth symbol, the circuit is automatically put right.

This leaves two condensers bypassing the "B" connection to the audio transformer and obviously both of them are not necessary. We suggest dropping out the 0.1 mfd. condenser, leaving the 0.25 mfd. unit to do the job.

In this position, the condenser forms the earth return path for the audio currents flowing through the primary of the transformer. If this were the only consideration, a high value of condenser would clearly be preferable, since it should be effective at both bass and treble frequencies.

TIME CONSTANT

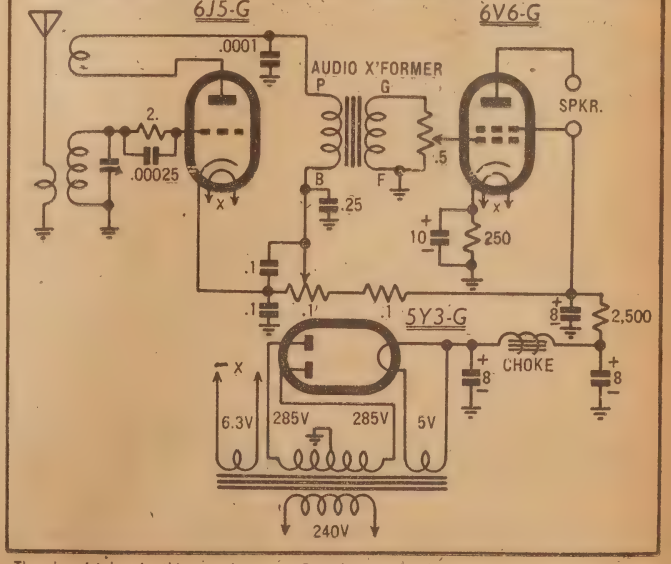
In practice, however, an excessively large condenser would take a noticeable time to charge and discharge through the controlling potentiometer. In other words, the effect of the potentiometer on the detector plate voltage would be delayed and the action of the regeneration control become sluggish. A value between 0.1 and 0.5 represents a good compromise.

The circuit around the 6V6-G is quite in order and the power supply is also a quite workable arrangement. One observation must be made, however.

With a 285 volt power transformer, the output from a 5Y3-G rectifier would be about 325 volts, this assuming a condenser input filter and a current drain of about 45 milliamps. The d-c drop across the filter choke is likely to be about 25 volts, leaving 300 odd volts for application to the valve.

This is unnecessarily high in a small set and 250 volts from plate to earth—240 from plate to cathode—is plenty. To get rid of the extra 50 volts at 45 milliamps, a series resistor of just over a thousand ohms would be required, dissipating continuously between 2 and 3 watts. From the experience we would recommend a 10-watt type.

The circuit, however, suggests a



There's mistakes in this circuit, too. Put them right, however, and the set should work very well.

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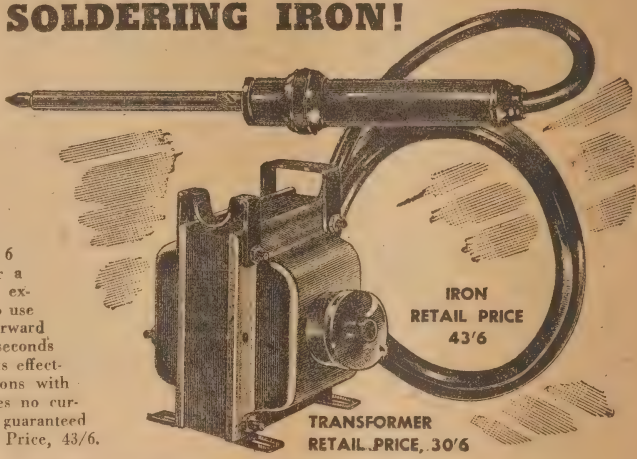

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value of 2500 ohms, which would drop the voltage much lower still. There may be plenty of output left but the resistor would run much hotter, owing to the extra heat dissipation. In other words, it is an unnecessarily high value for the particular power transformer used. A 385-volt transformer, on the other hand, would make the use of a large dropping resistor absolutely essential.

The final circuit is an unusual arrangement which could be very good or very bad according to the care with which it is adjusted. It is essentially a superhet, but with a regenerative detector and tuned circuit replacing the usual I.F. transformers and amplifier.

THE MIXER

The incoming signal is fed to the grid of a high-gain pentode mixer and, into this same grid circuit is injected the voltage from a local oscillator. Plug-in short-wave coils are used, and tuned by separate condensers. Thus far, the circuit does not depart appreciably from standard practice.

However, the output from the 6A67 mixer goes first through a feedback winding to produce regeneration and force additional gain from the mixer. A potentiometer shunted across the coil controls its effect.

From the feedback winding, the plate current passes to the primary of an R.F. coil with reaction, the secondary being arranged to tune from 3 to 5 mc. This coil is coupled to a 6SH7 as a regenerative detector, the output passing to a KT61 audio stage.

For normal work, the second tuned circuit can be left at say 4 mc. and the 6SH7 brought to the point of oscillation. In other words, the intermediary frequency is set at 4 mc.

A signal is then tuned in the normal way, the aerial circuit peaked for maximum response and the mixer regeneration brought up as necessary.

If now, the oscillator is left at its original frequency and the 6SH7 circuit varied, the set tunes to either side of the original signal by virtue of the varying I.F. rather than the usual varying oscillator. The interesting point is that the spread is always 1 mc. either side of the original centre frequency, irrespective of what the centre frequency happens to be. In other words, the bandspread effect is provided by the I.F. channel, and the spread itself is a constant figure.

HAS BEEN USED

Having explained the operation of the circuit, we can proceed to make a few observations about its design.

The general principle is not new and has been used in Europe more than anywhere else. It has obvious difficulties in a larger set where attempts may be made to achieve good I.F. characteristics. However, it can be employed quite well in a double-change superhet, making the first I.F. variable and the second fixed. The operation is then similar to the combination of a short-wave converter and a broadcast set. The bandspread on the broadcast dial is well known.

Whatever method is used, care has to be taken to avoid letting strong signals into the variable I.F. channel or they will be tuned simultaneously with stations on the required band.

Regeneration applied to the mixer certainly gives "free" gain, but it is likely to bring trouble in its wake, also "free." Unless everything is "just so," attempts to apply regeneration to a high-gain valve, particularly a type like the 6AC7, lead simply to uncontrollable oscillation. Incidentally the 5.0 meg. grid resistor sounds rather high. Something like 0.1 meg would be nearer the mark.

Your choice of a 7193 and voltage regulator may mean that these valves are on hand. The 7193 is physically rather awkward, as also is the Colpitts circuit where neither side of the tuning condenser is earthed. Electrically, it would have nothing to recommend it over the usual cathode-tap pentode scheme.

Coming to the voltage regulator, the use of a 3000 ohm series resistor is cutting matters rather fine. Ideally, the series resistor should be of such a value that, even if the controlled valves should be withdrawn from their sockets, the current through the regulator should not exceed ratings of, in this case, 30 milliamps. To drop from 300-odd volts to 150 at a current not exceeding 30 milliamps, the resistor would need to be a lot higher than 3000 ohms. We would suggest at least 5000 ohms and possibly a little higher. Don't connect an 8 mfd across the regulator tube, either, or you may be troubled with low frequency oscillation.

WHAT kind of circuits are most interesting to beginners? What kind of gadgets do you like building best of all? What kind of articles do you want to see in "Radio and Hobbies? Let us have your ideas and we will do our part.

VOLTS TOO HIGH

Actually, the voltage on the high tension line is likely to be on the high side, anyway, and you could well stand an extra filter choke and condenser, both to drop the voltage and to give extra filtering.

The rest of the circuit is in order, although we would suggest a spot of extra bias on the output valve. As the circuit stands, with the KT61 and the VR150-30 going "full bore," the 6X5-GT will be loaded to the hilt.

Well, that's that, R.W., of Mackay Queensland. We are not sure whether you have the set in operation yet but allow for the suggested change and we'll be very interested to hear how it performs.

"TREBLE TROUBLE" IN AMPLIFIERS

By W. N. WILLIAMS

The performance of an amplifier may be upset, particularly in the treble register, by electrical components and qualities which never appear in the circuit diagram. At the worst, they may cancel the benefits derived from a wide range speaker and pickup. Read this article and you may save yourself and few "db" at the top end.

A GOOD deal of the treble loss which occurs in an amplifier may be blamed on so-called "Miller" effect and on wiring capacitance—in particular, the use of shielded hook-up wire.

There is nothing very new or shattering in this statement, for both effects have received due mention in text books. The point of the matter is simply that they are frequently overlooked by designers and constructors alike, to the detriment of the high frequency response.

But what is this "Miller" effect? It obviously takes its name from the engineer who first apprehended and analysed it.

Figure 1a shows a typical triode amplifier stage, with a signal input which has been designated by the letter "e." By a familiar process, the signal will appear in the plate circuit considerably amplified.

If the gain of the stage is designated, as is usual, by the letter "M," then the amplified signal must have a value of M times e volts. Since it is out of phase with the grid voltage, it is normally given a negative sign so that it appears on the drawing as "-M x e."

This is the obvious and elementary function of the circuit. What is not so apparent is the fact that there is an inevitable capacitance between the grid and plate of the valve which causes some of the energy in the plate circuit to be coupled back to the grid.

The circuit is actually as shown in figure 1b, the coupling capacitance being represented by the quantity Cg-p. It is equal in value to the grid-plate capacitance of the tube, the capacitance across the socket, and the stray capacitance between the grid and plate wiring.

The voltage coupled back to the grid suffers a further phase rotation because of the capacitance and its presence in the grid circuit gives the valve an input characteristic exactly as if a condenser were physically wired between grid and earth. This constitutes "Miller effect," insofar as it applies to resistance-coupled amplifiers.

The obvious question follows:—What value is this artificial capacitance likely to assume?

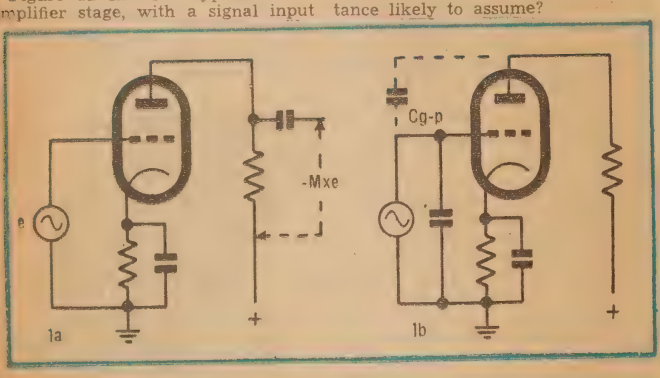


Figure 1a shows a rudimentary triode circuit, while 1b includes the apparent capacitance effects which tend to limit high note response.

Expressed as an equation, Miller effect is:—

Cm equals Cg-p (M plus 1).
Where Cm is in pf.,
M is the stage gain,
Cg-p is the total grid-plate capacitance in Pf.

The multiplier (M plus 1) takes into account the original phase displacement between the grid and plate voltages. The arithmetic difference between them is obviously the plate signal (M x e) plus the original signal e. In other words, the difference factor between the instantaneous grid and plate voltage is M plus 1.

To this must be added the normal input capacitance of the valve, representing the capacitance between grid and cathode and also between grid and screen for a pentode.

For a pentode amplifier, Miller effect is mercifully very small, due to the inherently low grid-plate capacitance.

TYPICAL PENTODE

In the case of a 6SJ7, Cg-p is quoted as .005 pf. Thus, even if one allows for a stage gain of 200 times, the Miller effect capacitance does not rise above about

200 x .005 equals 1 pf.

Add to this a figure of 6.3 pf. for the natural input capacitance and the total grid input capacitance attributed to the tube does not exceed about 7 pf. This is quite typical for a pentode voltage amplifier and forms a basic reason why pentodes are the best choice as voltage amplifiers in wide band amplifiers.

In the case of a triode, the position is not such a happy one. Most general purpose triodes exhibit a grid-cathode capacitance and the and 4 pf. for a stage gain of about 15 times. Thus, Miller effect capacitance amounts to about 3.5 x 16, equals 56 pf. Add to this the normal grid-cathode capacitance and the total figure approximates 60 pf.

A high-mu triode is the worst offender of all. Taking the 6B6-G as an example, the grid-plate capacitance is 1.7 and the gain 60 times, giving a figure which exceeds 100 pf.

EFFECT OF WIRING

These figures represent the bare minimum which can be expected. In practice, they would be increased by circuit capacitances external to the valve between grid and earth.

Most damaging of all are wiring methods, which may increase the grid-plate capacitance and therefore the Miller effect. It is most important to avoid dragging grid wires over plate pins and vice versa, or mixing up the grid and plate components of a single stage in the one heap. As little as 1 pf. of grid-plate capacitance introduced in this way around a pentode amplifier may cause it to acquire an input capacitance of 100 or more pf. The lesson is obvious.

So much for Miller effect. A second and equally important factor is the amount of capacitance introduced into amplifiers by the use of shielded wire. Shielding is often

necessary in amplifiers, as a precaution against instability and hum, but there is a tendency to use it with gay abandon, forgetting the capacitive effects it may introduce.

Curious to know a few figures, we searched around and found samples of three different types of shielded wire commonly used by amplifier enthusiasts. We then snipped off exactly one foot of each and measured the capacitance between the inner conductor and the sheath.

The first sample had a stranded inner conductor, a layer of plastic insulation, then braided cotton and finally the copper braid. This showed a capacitance of 125 pf per foot and a power factor which would not have been questioned in a condenser of the same value.

MEASUREMENTS

The second sample was similar, except that it had rubber insulation instead of plastic. The capacitance measured 140 pf. and the power factor was poorer, although still adequate for its purpose in life.

Sample 3 gave us a shock. Of smaller diameter than the others, it had two layers of treated cotton between the conductor and sheath. The capacitance of 1 foot read no less than 625 pf. and the d-c resistance 35 megohms.

In other words, a typical run of this cable to and from a volume control across the chassis would bypass the grid by upwards of 1000 pf. and introduce 16 megohms of shunt resistance. Once again, the lesson is obvious.

By way of contrast, we snipped off one foot of the small-size 70-ohm coaxial cable, known in some quarters as type PT1M. We have previously suggested the use of this cable for certain audio links rather than shielded wire. The reading on the bridge was as clean as the reading from a perfect condenser and, what is more important, the capacitance read as 21 pf. per foot— just one-sixth of the best shielded wire and one-thirtieth of the worst.

These are all very interesting figures, but what do they mean in terms of frequency response? There is no simple answer to this, because it depends entirely on the a-c resistance of the circuit across which the capacitance is shunted.

IMPEDANCE

If this grid circuit in question happens to be fed directly from a low impedance pickup or a low impedance triode, or such like, a hundred pf. or so of shunt capacitance may cause only a slight droop at the top end. The real trouble comes when the effective a-c resistance from grid to ground gets up to 0.1 meg. and beyond. Don't take this figure too literally but it does at least set a mark in space.

Anyone faced with the job of designing a multi-stage amplifier with any pretence to fidelity should therefore watch impedance values and shunt capacitance in all its forms,

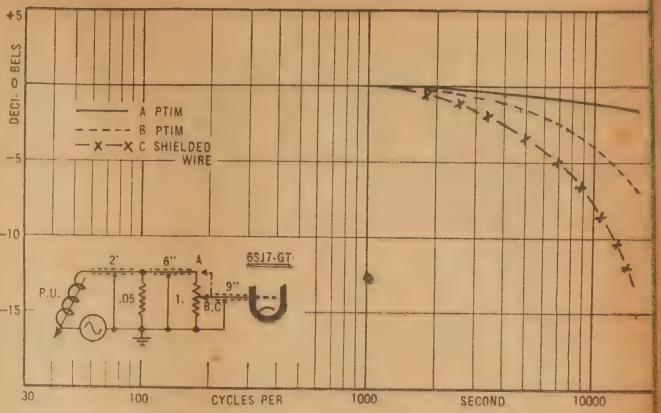


Figure 2. Even if care is taken to avoid Miller effect in the valve, shielding can do this to the response curve. Note the superiority of PTIM type cable, also the effects of mid-settings of the volume control.

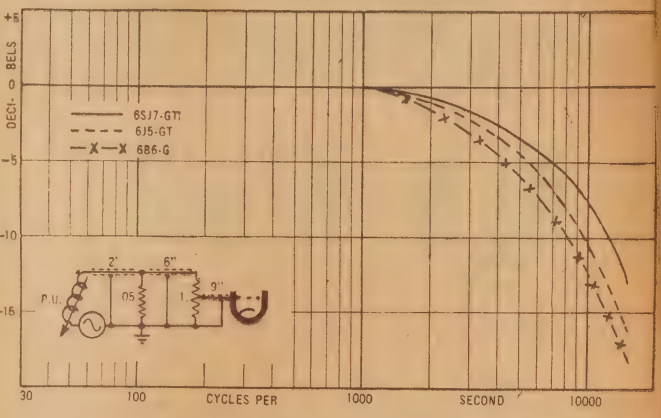


Figure 3. Shocking though these curves may appear, they hold for the input circuit of many amplifiers. Ordinary response curves ignore capacitive input losses, since they are plotted with a low impedance audio generator as the signal source.

remembering that the effects tend to accumulate, the losses in one stage adding to those in the next.

The real "hot spot" in most amplifiers centres around the volume control.

The reason for this lies in the amount of shielded wire which is likely to appear in this portion of the circuit, and also in the fact that the grid so fed is often at a high impedance with respect to earth for certain volume control settings.

By way of example, when the grid happens to be fed from near the centre of a 1.0 meg. potentiometer, the a-c resistance to earth cannot be less than 0.25 meg., representing the two halves of the potentiometer effectively in parallel. Thus, even though the potentiometer itself may be fed from a suitably low impedance source, the actual grid circuit may have sufficient impedance at intermediate settings of the control to be seriously affected by shielded hook-up and Miller effect.

An amplifier cannot therefore justly be claimed as "flat" until the curve is satisfactory at all settings of the gain control and with the generator input "doctored" to stimulate the conditions under which the equipment will actually be used.

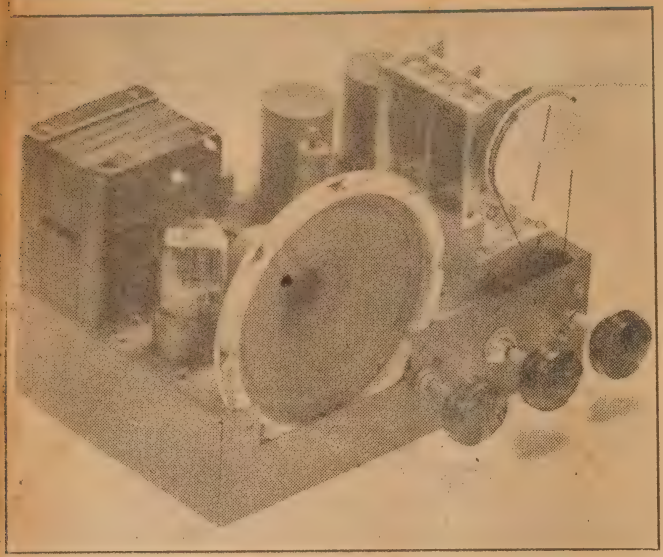
To discover just how serious the effects could be under quite ordinary conditions we ran a series of curves which are reproduced figures 2 and 3. They are based on average equipment.

PRACTICAL CASE

Examination of several receivers and amplifiers showed that they used anything from 15 to 30 inches of shielded wire in the grid, volume control, diode and pickup leads inside the chassis. External to the chassis, the shielded pickup lead is usually around the 2-foot mark. This can add up to a lot of shunt capacitance.

The circuits inset in each of curves

(Continued on Page 75)



Here is the set built on the "Little General" chassis. Controls from the left are, Volume, Reaction, Tuning. New holes were drilled in the chassis to take the smaller gang. When assembling the dial drive, see that the dial cord does not foul the chassis or drive shaft bracket.

A NEW MIDGET RECEIVER

Whether you want a set for general entertainment or for experiment, you will vote this circuit a winner. For two valves and a rectifier, it has a performance which must be heard to be believed and yet it is simple enough for the near-beginner. Taking but one or two evenings to complete, it will provide that "second set" in the kitchen or bedroom.

by Raymond Howe

LAST month we gave the circuit diagrams and the broad details of two small a-c sets of British design and using type EF50 ex-disposals valves. With a view to converting the designs to suit Australian components, we are featuring here the two-valve version, plus a rectifier.

In testing this set, we found that with an aerial of average length we were able to tune in all of the Sydney stations at full speaker volume, with a few others into the bargain. The set handles with comparative ease. You may find it possible to set the regeneration control at the high frequency end of the broadcast band and to tune the local stations without having to touch anything other than the tuning knob. It will be necessary, believe it or not, to turn the volume down on some stations!

The selectivity is good also for this type of set. Of course, as with any regenerative detector, the degree of selectivity is governed to a considerable extent by the setting of the regeneration control and the need for careful adjustment will be greater in some districts than in others.

Obviously, the later addition of an RF stage will aid noticeably in the matter of selectivity, to say nothing of the improvement in general sensitivity.

The secret of the success with this set lies in the use of the high-gain EF50 type valves. The fact that this valve type was used throughout the war in many items of British electronic equipment testifies to its capabilities. These valves have been available in Australia in large quantities through the Disposals sources.

With this high-gain valve, the output from a leaky-grid detector is greater than with a standard RF pentode. In the role of power output pentode, the EF50 is capable of delivering about 500 milliwatts for a grid drive of 1 volt. With such figures as these, it can be seen that two such stages can give a healthy account of themselves even with an HT supply of 180 to 190 volts.

At the outset, we did not attempt to build this set into the "cigar-box" class. Rather, it was laid out with a view to giving the beginner a "clear go," so that he need not strain his ingenuity and patience in trying to fit components into a restricted space. Nevertheless, it is small enough to sit on the bedside table or the kitchen cabinet without having to reorganise things every time it is moved from one room to another.

Hence the Little General chassis and cabinet.

EXISTING CHASSIS

Another point is that we do not want to specify new chassis designs unnecessarily and, with this standard chassis, very little modification is necessary. Comment on this point will be made later.

Apart from the valve types, unusual features about this set are the use of negative feedback, the form of volume control and the method of aerial coupling.

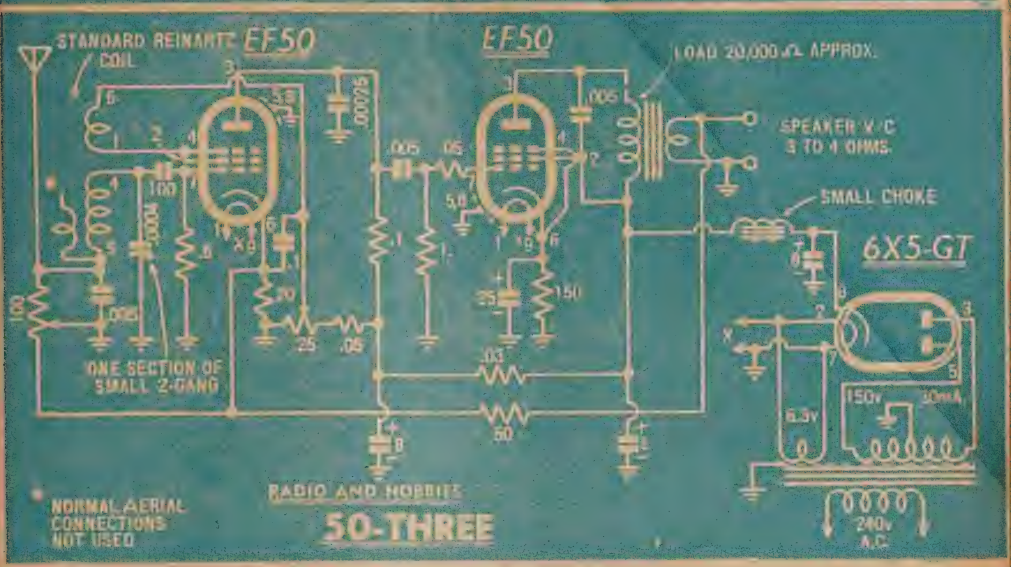
The conventional aerial terminals on the standard Reinartz coil are not normally used. The alternative coupling method is to connect a capacitor between the bottom end of the grid winding and earth and this has much the same electrical effect as tapping the aerial well down the grid winding. Since the impedance across the .005 mfd capacitor is only a few ohms, the damping effect of the aerial upon the "Q" of the tuned grid winding is only a few percent. Another good point is that varying the length of aerial does not shift the stations up and down the dial to any extent.

LIGHT COUPLING

In other words, what is achieved by this method of aerial coupling to the grid circuit is very low input impedance and light coupling. It is actually much less than that obtained when using the normal "long" aerial terminal of the standard Reinartz coil. This is an advantage in strong signal areas, since damping must be kept to a minimum where there is but one tuned circuit to govern the selectivity.

In remote areas, better results may be had by using one of the conventional connections on the coil for the aerial, and some may even like to provide alternative aerial terminals. This is a matter for actual trial.

CIRCUIT DIAGRAM OF THE 50-THREE RECEIVER



Just two valves and a rectifier but surprising performance. The filter choke is optional as mentioned in the text. With this form of aerial coupling, the normal aerial connections to the Reinartz coil are not used. Note that only one section of the 2-gang tuning condenser is required, the second section being used when the RF stage is added.

The value of the grid resistor has an important effect upon the selectivity and general behavior of the detector. Too low a value shunts the tuned circuit, while too high a value may produce instability. The value of .5 megohm is about optimum.

Although a 2-section tuning gang is shown in the photographs, and in the parts list, only one section is in use for this version of the set. The second section will be used when the RF stage is added later. It is just as easy to mount a 2-section on the chassis at the beginning rather than to change from a single-section condenser to the 2-section when the RF stage is added and furthermore, the difference in price is not very great.

SCREEN CONTROL

Regeneration in the detector is controlled by varying the screen voltage, a method which gives smooth operation. It also keeps the "hot" RF leads confined about the coil and the detector socket and helps to reduce the amount of troublesome RF energy in the plate circit of the valve. No RF choke is used in the plate circuit, the single mica bypass capacitor being sufficient.

The HT feed to the screen and plate of the detector is decoupled by a .03 megohm resistor and an 8 mfd. electrolytic to prevent any hum component from being amplified by the output valve. The actual value of these components is not critical and may be varied to make use of parts on hand. For instance, the resistor could be anywhere between, say, .015 and .05 megohm, and the capacitor anywhere between about .5 mfd. and 8 mfd. The larger values, particularly of capacitor, give the better hum reduction.

The coupling between the detector plate and the output valve is quite conventional. The .05 megohm resistor in the output valve grid circuit is there as a precaution against parasitic oscillations possible with high-gain valves. This resistor is usually known as a "grid-stopper."

The standard cathode bypass across the 150 ohm cathode resistor of the output valve should, ideally, be of a somewhat larger value for improved bass response. However, considering the use of a 5 inch speaker and bearing in mind the impedance of the output transformer, any improvement in bass response with an increase of the value of the cathode bypass capacitor could scarcely be noticed.

Some form of high-note attenuation is necessary in the output circuit of the power valve to remove the ... kc adjacent channel interference which is peculiar to any receiver with a broad selectivity characteristic. This is achieved by wiring a suitable condenser across the primary winding of the output transformer.

A value of .005 mfd. is about optimum.

OUTPUT TRANSFORMER

The load requirement of the EF5 valve, when operating as a power pentode, is of the order of 20,00 ohms. It is virtually impossible to produce a midget transformer to reflect this load, and, at the same time have enough inductance to ensure good bass response. To offset this lack, negative feedback is introduced

PARTS LIST

1 chassis 8⅛" x 5½" x 2¼" (Little General).
1 power transformer 150v. per side at 30mA, 6.3v. winding.
1 Cabinet to suit (optional).
1 small filter choke (optional, see text).
1 miniature 2-gang condenser (single-gang if RF stage will not be added).
1 dial (EFCO MK/17A or similar).
1 Reinartz coil.
1 5-inch speaker, 1 small speaker transformer to match voice coil to approx. 20,000 ohm load.
2 EF50 valves, 1 6X5-GT rectifier.
2 EF50 sockets, 1 octal socket.

CONDENSERS

3 8 mfd. electrolytic capacitors.
1 25 mfd. 40 pv. electrolytic capacitor.
1 .1 mfd. 200v. tubular, 3 .005 mfd. tubulars, 1 .00025 mfd. mica.
1 .0001 mfd. mica.

RESISTORS

1 1 meg. 1 .5 meg., 1 .25 meg. potentiometer, 1 .1 meg., 2 .05 meg., 1 .03 meg., 1 150 ohm, 1 100 ohm wire-wound potentiometer, 1 50 ohm, 1 20 ohm.

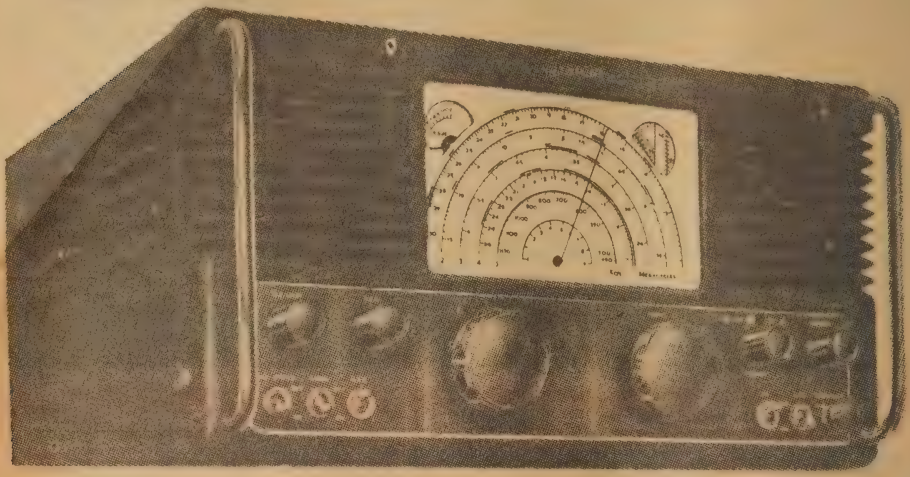
SUNDRIES

3 knobs, 2 terminals (1 red, 1 black), 3 3-tag mounting strips, 1 tapped mounting pillar, nuts and bolts, solder lugs, hook-up wire, power flex and plug, solder, &c.

EDDYSTONE

British High Grade Communication Equipment

The Eddystone tradition for quality workmanship is fully upheld in the wide range of Eddystone receivers, embodying years of experience in the design of short wave equipment.



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EDDYSTONE MODEL 680 DE LUXE (as illustrated)

A new 15 valve professional communications receiver of advanced technique.
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Continuous coverage, 30 Mc/s to 480 Kc/s.
Two radio - frequency stages.
Two I.F. stages.
Crystal filter.
Push-pull output stage.
Variable Selectivity.
"S" meter.
Noise limiter
Stabilised HT voltage to oscillator, etc.
A.C. operation.

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EDDYSTONE MODEL 750.

An entirely new ultra-modern amateur bands receiver. Special features:

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New miniature valves. 3 watts audio. Double detection super heterodyne (1600 and 85 Kc/s). Stabilised H.T. Supply. Provision for external "S" meter.

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Crystal filter.
R.F. stage.
2 I.F. stages.
Provision for "S" meter.
Noise limiter.
9 valves.
Electrical band spread.
High sensitivity on all bands.
A.C. operation or from 6-volt battery.

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Eddystone 670 is specifically designed for marine use operation, on A.C. and D.C. voltages.

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7 valves, plus selenium rectifier.
Push-pull output.
"Thermistor" prevents high initial surges.
Special screening prevents interaction between receiver and other receivers on board ship.
Expanded tuning scale provides 90 inches of scale for each range.
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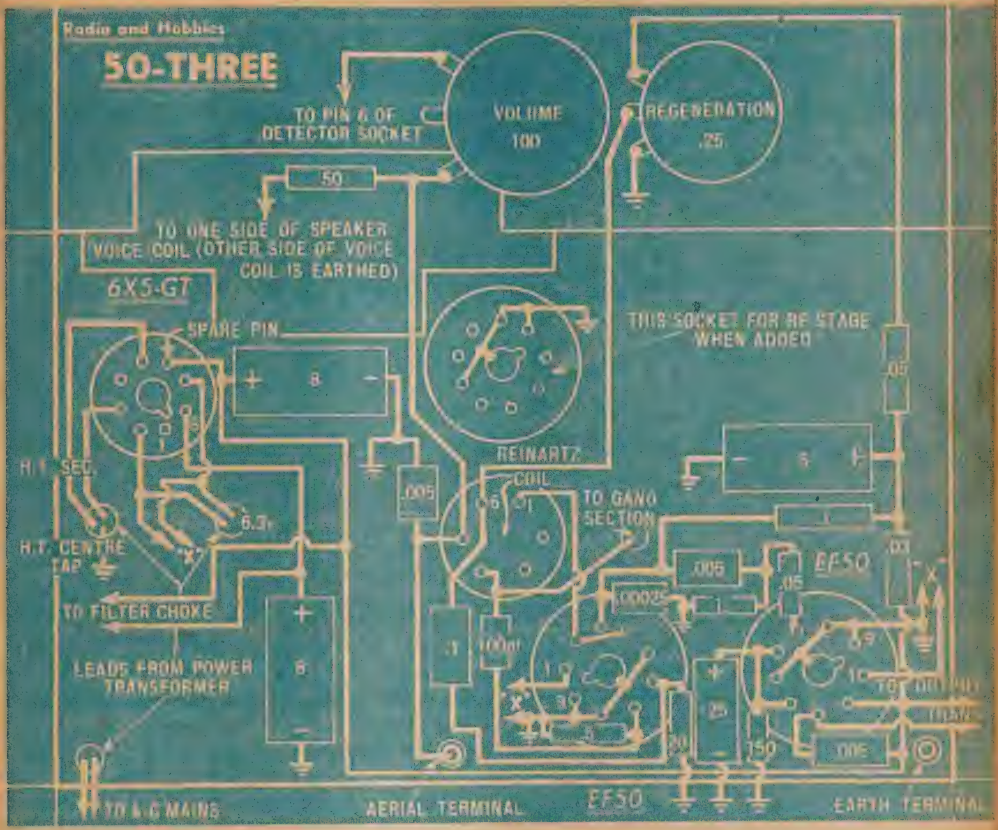
FULL DETAILS OF THE UNDER-CHASSIS WIRING



This wiring diagram will assist those who still have difficulties with schematic circuits. Compare with the photograph overleaf.

between the voice coil winding of the transformer and the cathode circuit of the detector.

One side of the voice coil winding is therefore, earthed and the other side is connected to one end of two resistors in series. The second resistor is in the cathode circuit of the detector valve. Tracing this arrangement out, you will see that the two resistors are in series across the voice coil winding, one side of which is earthed. The cathode of the detector valve is tapped into this resistive load at the junction of the two resistors.

SPEAKER IMPEDANCE

For a speaker voice coil impedance of 3 to 4 ohms, a value of 50 ohms for the larger resistor is a good compromise when the resistor in the cathode circuit of the detector valve is about 20 ohms. It is necessary to keep the cathode resistor down fairly low so that the small positive bias which will develop does not upset the detector operation.

The feedback circuit can be arranged to provide a form of volume control if we include some means of varying the feedback factor. This can be done by shunting the 20 ohm resistor in the detector cathode with a variable resistor as shown.

At one setting, full negative feedback is in effect, whilst, at the other extreme, the feedback is shorted out and the maximum gain is available.

To overcome the minimum-volume effect with this form of control, the free end of the variable shunting resistor is connected to the aerial. Thus, as the full feed-back is coming into effect, the aerial is gradually being shorted to earth. This arrangement can only be worked satisfactorily with a low impedance aerial connection, such as we are using.

Resistor Color Code

VALUE	BODY	END	DOT
1 megohm	Brown	Black	Green
0.5 megohm	Green	Black	Yellow
0.1 megohm	Brown	Black	Yellow
0.05 megohm	Green	Black	Orange
0.03 megohm	Orange	Black	Orange
150 ohms	Brown	Green	Brown
100 ohms	Brown	Black	Brown
50 ohms	Green	Black	Black
20 ohms	Red	Black	Black

The value of this potentiomet volume control is not open to ve wide variation. We used the val of 100 ohms, because it is, mo or less, a standard size held in sto at most radio supply houses. A ohm size could give a smoother co trol over the extremes of the rang On the other hand, anything mu larger than 100 ohms will produ what will appear a rather abru "full on" and "full off" effect, wi little change in volume over t intermediate portion of the contr range.

We agree that the regenerati control can act as a volume contr and it is often employed that wa However, as it also varies the degr of selectivity, it is much more co venient to have a separate contr for the volume, leaving the adjus ment of regeneration to control t selectivity.

POWER SUPPLY

The power supply is quite a simp affair, employing the smallest ava able standard power transformer. is rated at 150 volts per side 30 mA for the HT secondardy win ing and has one 6.3 volt heater win

STANDARD -FERGUSON- RANGE

POWER & VIBRATOR TRANSFORMERS

		A.C.	Vib.			Retail
PF 122	240	6	220	40	6.3V @ 2A	33/6
PF 125	240	6	250	60	6.3V @ 2A	43/-
PF 119	240	6	325	125	6.3V @ 4A	62/-
PF 182	240	12	200	40	12.6V CT @ 1A	33/6
PF 126	240	12	250	60	12.6V CT @ 1A	47/6
PF 146	200,30,40	12	325	150	12.6V CT @ 2.5A	67/-

FILTER CHOKES

	Induct	D.C. Res.	M.A.		Retail
F 100	50	1900	10		18/-
F 101	30	870	25		18/-
F 102	15	400	60		12/-
F 103	30	420	60		26/-
F 104	30	580	75		31/-
F 105	15	250	80		24/-
F 106	12	200	100		24/8
F 107	30	360	100		34/8
F 108	12	135	150		35/-
F 109	20	225	150		37/8
F 110	12	100	200		43/8
F 111	16	165	200		45/10
F 112	10	70	250		46/2

SPECIAL CHOKES

F 113	.5	70	250			
	20		50	Swinging choke		50/6
F 114	1.1	23	375	Ballast choke		24/-
F 115	.017	.6	2 amps	L.T. choke		10/-

OUTPUT TRANSFORMER TO VOICE COIL

Full Frequency Range (30-15000)

Code No.	Pri. Imped.	Sec. Imped.	Watts	Retail
OP24	5000 SE	8.4, 2.1, with feed back	5	44/10
OP23	3250 SE	12.5, 8.4, 2.1	10	65/1
OP19A	5000 PP	12.5, 8.4, 2.3	15	102/10
OP51	4500 PP	15.5, 12.5, 8.6, 2.8, 2	20	36/9
OP63	10000 PP	15, 3.75	15	100/-
OP64	10000 PP	12.5, 3.125	15	100/-
OP65	10000 PP	8.4, 2.1	15	100/-

OUTPUT TRANSFORMER TO VOICE COIL

Special Full Frequency (20-30,000)

OP25/40	10000 PP	40, 10	15	130/-
OP25/16	10000 PP	16, 4	15	130/-
OP25/15	10000 PP	15, 3.75	15	130/-
OP25/12	10000 PP	12, 3	15	130/-
OP25/10	10000 PP	10, 2.5	15	130/-
OP25/8.4	10000 PP	8.4, 2.1	15	130/-
OP66	5000 PP	8.4, 3.7	15	130/-
OP67	5000 PP	15, 6.5	15	130/-

OUTPUT TRANSFORMER TO LINE—

Full Freq. Range.

OP22	3250 SE	500, 125, 8.3	10		65/1
OP19b	5000 PP	500, 250, 125	15		102/10
OP21	8000 PP	300, 250, 125	15		82/10
OP62	10000 PP	500, 125	15		100/-

OUTPUT TRANSFORMER TO LINE—

Special Full Freq. Range

OP25/500	10000 PP	500, 125	15	130/-
OP25/250	10000 PP	250, 62.5	15	130/-

VIBRATOR TRANSFORMERS

Code No.	Pri. V.	D.C. Out.	MA	Buffer Full Sec.		Retail
VT 100	6, 12	200	40	.005	Sync.	27/-
VT 101	6, 12	90	15	.008	"	18/6
VT 102	6	150	25	.005	"	23/10
VT 103	6	200	50	.005	"	25/-
VT 104	6	250	60	.005	"	37/-
VT 105	12	250	60	.005	"	37/-
VT 106	6	300	75	.008	"	52/-
VT 107	6	250	60	.005	Sync. Low Rad.	30/6
VT 108	12	90	15	.008	Sync.	21/8
VT 109	24	90	15	.008	"	23/8
VT 110	12	150	25	.005	"	23/10
VT 111	24	150	25	.005	"	26/6
VT 112	12	200	50	.005	"	25/-
VT 113	24	200	50	.005	"	26/6
VT 114	12	300	75	.008	"	54/2
VT 115	24	300	75	.008	"	55/6
VT 116	24	250	60	.005	"	30/-
VT 117	12	250	60	.005	Non Sync. Low Rad.	31/-
VT 119	32	150	25	.005	Sync.	25/6
VT 121	6	180	30	.005	"	25/4
VT 122	6	400	50	.005	"	50/-
VT 123	12	320	125	.005	Sync.	63/3
VT 124	32	250	60	.005	"	30/-
VT 127	6	200	50	.005	Sync. Low Rad.	29/8
VT 128	12	250	60	.005	Sync. Low Rad.	38/-

RECEIVER POWER TRANSFORMERS

Code No.	Prim.	HTV Aside	M.A.	Filaments	Retail
PF 185	240	150	50	6.3V @ 2A	24/-
PF 106	240	325	45	6.3V @ 2A, 5V @ 2A	30/-
PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	30/-
PF 153	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	34/-
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	34/-
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	46/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	46/-
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	56/-
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	66/-
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	60/-
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	70/-
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	110/-
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	111/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	144/-

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	
MT111	500	12.5, 8, 2.3	10	36/9
MT100	600	4, 3	15	36/9
MT101	500	15	15	36/9
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	66/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	66/-

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000, 5000	25	85/-
MT119	8000, 6600, 3800 PP	1000, 7500, 6500, 5500, 4500, 3500.	50	111/-
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	200/-
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	276/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	39/10
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	45/8
OP39	5000, 2500 SE	15	10	39/10
OP33	5000, 2500 SE	5, 2.7	10	39/10
OP41	5500 SE	3.7	10	46/-
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.3	10	36/9
OP2	5000 PP	12.5, 8, 2.3	15	65/1
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP3	6600 PP	12.5, 8, 2.3	15	65/1
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP4	10000 PP	12.5, 8, 2.3	15	65/1
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	65/1
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	76/2
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	93/8
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	116/8

OUTPUT TRANFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	39/10
OP44	5000, 2500 PP	500, 250, 125	10	47/-
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	81/4
OP6	5000 PP	500, 250, 125	15	65/1
OP7	6600 PP	500, 250, 125	15	65/1
OP50	8000 PP	600, 300, 120, 60, 30	15	126/-
OP8	10000 PP	500, 250, 125	15	65/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	71/3
OP9	10000, 6600, 5000 PP	500, 250, 125	15	65/1
OP10	5000 PP	500, 250, 125	25	81/10
OP11	6600 PP	500, 250, 125	25	81/10
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6.	25	140/-
OP12	10000 PP	2.7	25	81/10
OP13	10000, 6600, 5000 PP	500, 250, 125	25	81/10
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	120/-
OP14	5000 PP	500, 250, 125.	32	102/10
OP48	6600 PP	140, 70	32	113/8
OP15	6600 PP	500, 250, 125	32	102/10
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	104/1
OP16	10000 PP	500, 250, 125	32	102/10
OP17	10000, 6600, 5000 PP	500, 250, 125	32	102/10
OP36	3800 PP	17.6	60	108/7
OP18	3800 PP	500, 250, 125	60	108/7
OP61	3800 PP	100, 75, 25, 10, 5, 2	60	133/8
OP37	6400 PP	500, 250, 125	80	150/8
OP49	8800, 6000 PP	500	105	210/-
OP20	11600, 8400 PP	500, 250, 125	150	276/-

ing. Because there is but one 6.3 volt winding, the choice of rectifier valve is limited to the 6X5-GT. Of course, that was the point in mind when the transformer was designed. Note that one side of the 6.3 volt heater winding is earthed to the chassis. This is common practice in preventing circuit instabilty.

You are not necessarily limited to the use of this particular transformer. Almost any transformer and rectifier can be used which will deliver to the output valve a voltage of about 250 or under. The current drain is very low, being of the order of 11 to 12 mA. The later addition of the RF stage will not add very much to this.

CHOKE OPTIONAL

With such comparatively low current drain, the filtering does not present much of a problem. We have shown a single-section capacitor-input filter, using two 8 mfd. electrolytics fore and aft of a small filter choke. Almost any choke will do, provided that it will fit underneath the chassis.

If you have no suitable choke on hand, you could omit it and rely on a single filter capacitor of large value. In this case, the filter capacitance value will need to go up to at least 24 mfd. or higher for the same degree of hum reduction. In addition, use an 8 mfd. for the detector plate circuit decoupling capacitor.

Well, that's all there is to the circuit design. As far as the practical side of the question is concerned, most constructors will find little difficulty. However, bear in mind that you are dealing with high-gain valves and so keep the detector grid circuit wiring well away from the plate circuit of the output valve. Under certain conditions of coupling between the input and output circuits of the power valve, it could oscillate its head off.

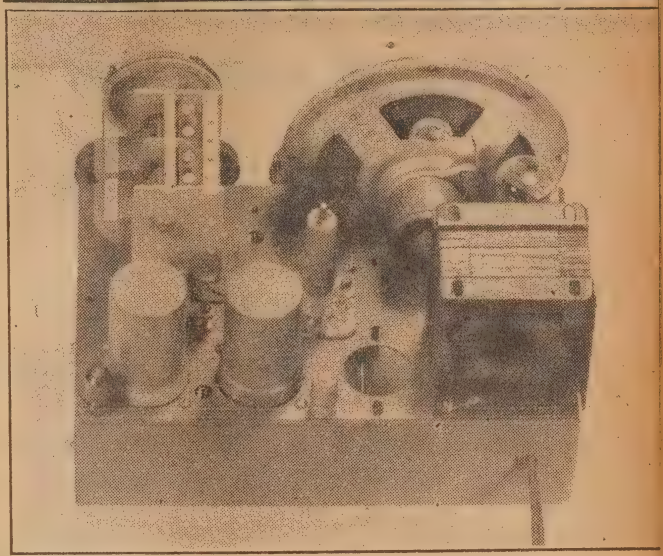
While on the matter of unwanted positive feedback, you will need to find by experiment whether the correct side of the output transformer voice coil winding is being used for the negative feedback to the cathode circuit of the detector. If, when you first switch the set on, the volume control operates in reverse and causes squeals, it's a foregone conclusion that you have picked the wrong side of the voice coil winding for the negative feedback. You can either re-solder the 50 ohm feedback resistor and the earth on to the alternative sides of the voice coil winding or reverse the connections of the primary winding to the plate and screen of the output valve.

EARTHING

It is a good plan in the early stages of the wiring of the set to connect all earth points by a run of tinned copper wire.

Remember that the connection to the shield-can of the EF50 valves comes out of the valve base via pins 5 and 8. Either of these pins may be earthed. Another point, too, is that the spring clip of the EF50 socket, by which the centre spigot of the valve is gripped, should also be earthed.

REAR VIEW OF THE CHASSIS

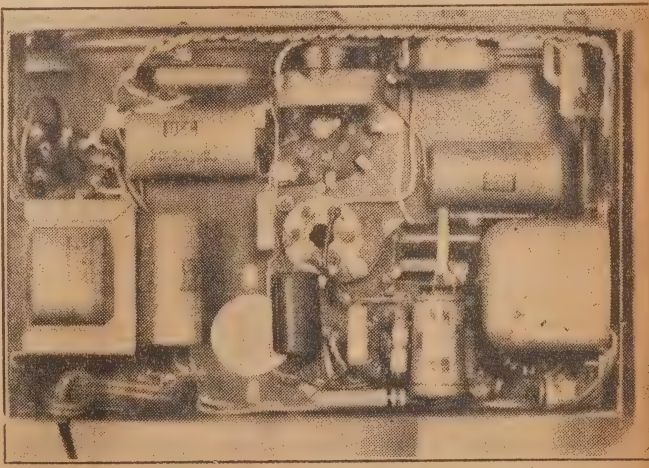


This plan shows which holes of the chassis are used. The output valve is in the left-hand corner near the earth terminal, while the detector valve is in the centre with the aerial terminal close by. The rectifier is at the right. Note that the valve holes are enlarged to take the EF50 valves.

The wiring diagram does not show any connection to the centre lug of the volume control. The point is that usually both the shaft and the centre lug is connected to the moving arm of a wirewound potentiometer and as the shaft is already making contact with the chassis, there is no need to earth the centre lug.

In the initial treatment of the chassis, it will be necessary to enlarge the valve holes to allow the EF50 type valve to fit into its socket properly. This is easily done with the aid of a good half-round file and the temporary forbearance of the other occupants of the house. About 3/16th of an inch increase in the radius of the appropriate holes will do the trick.

Other new holes are those for the mounting of the tuning gang, the output transformer, the filter choke, and one for the speaker. The power transformer will use two existing holes but will require two more. Only three bolts are used to hold



The Reinartz coil is in the centre of the photo, the filter choke to the left and the speaker transformer on the right. A spacing washer allows the volume control to clear the edge of the speaker frame. The spare socket for the future RF stage is behind the control.

the transformer, the primary winding leads being taken through the fourth hole near the rear edge of the chassis. All of the leads to the secondary windings are taken through existing holes near the rectifier socket.

The fitting of the speaker will depend largely upon the type and consequent frame shape of the one you have. In our case, we filed two protruding corners of the existing cut-out so that the speaker sat in position, to be held in place by one bolt only.

TUNING GANG

In the mounting of the tuning gang, the usual mounting brackets which are supplied were used and the whole assembly was raised about half an inch above the chassis by bolts and additional nuts. This allows the whole gang and the attached dial drum to be positioned in the centre of the cut-out in the cabinet for the dial escutcheon.

In the original "Little General" cabinet only two knobs protruded through the front to balance with the layout of the dial escutcheon and the speaker fret. If you want to keep the number of controls protruding through the cabinet front down to two, you could possibly mount the regeneration or the volume control at the back of the chassis so that it takes on the form of a partial preset control. Which of the two you leave at the front depends a good deal on your individual set and location.

We expect that the performance of the version with the RF stage will allow this to be done with the regeneration control. However, we suggest that you become familiar with the capabilities of the set in your particular location before fitting it into the cabinet, and then to make the choice about the positioning of the controls to suit yourself.

INTERFERENCE

Well, that's the story of a little set which is capable of surprising you with its performance. However, one final point to the beginners who have not built or used this type of set before. Attempt to avoid having the detector in a state of oscillation when tuned to a station, particularly a local station, because in this condition it will radiate interference to other neighboring sets which happen to be tuned to the same station. Although you may not be aware of the interference being caused, the neighbors soon will be, and, possibly, much to your embarrassment.

Last, but not least, you may find that a good earth lead improves reception. In some cases, it may not. It depends a lot on the characteristics of the aerial. It's worth while remembering that there is a handy earth system in most electrical power point wiring. Just use a three-core power flex, connect the green wire, which is the earth wire, to the chassis of the set at one end and to the earth pin of the usual three-pin flat plug at the other, and there you are.

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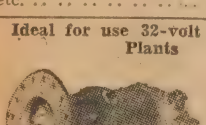

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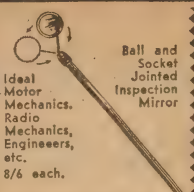

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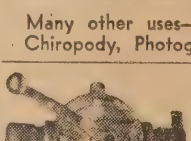

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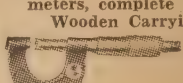

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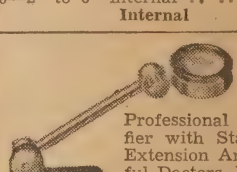

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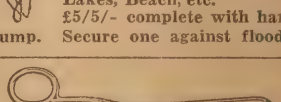

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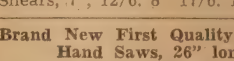

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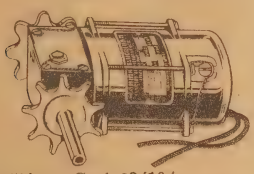

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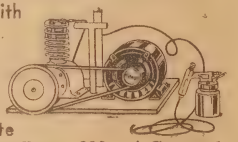

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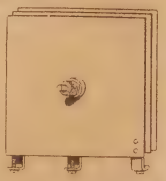

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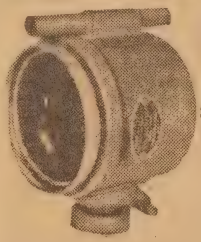

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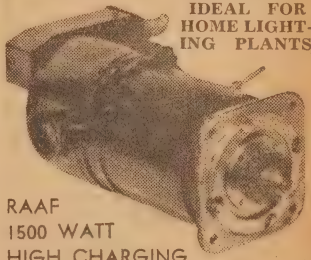

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Here's your answer, Tom!

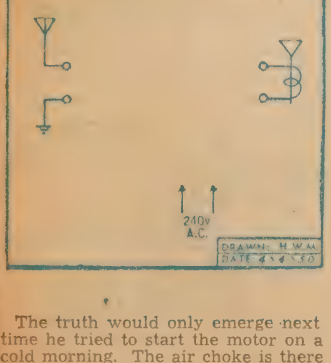
There is no doubt that Tom is a very bright boy. He has discovered that parts can be left out of a set without apparently affecting its performance. Maybe all the bits and pieces in a radio are put in just for show.

TO be more specific, Tom throws this question into the arena:—

In my one-valve receiver, I omitted the RF choke and results were splendid. Why, then, is the choke used?

Just so you won't lose faith in humanity, Tom, let's hasten to assure you that there is no infamous tie-up between the publishers of radio magazines and the manufacturers of radio parts. We don't specify bits and pieces in our circuits unless we think they are important.

The instance you have picked on may be likened to the choke in a motor car. The driver could get to work under the bonnet and emerge with a handful of levers and screws which constitute the said device. He could then slide into the driver's seat and proudly drive off, thereby demonstrating that the gadget was entirely superfluous.



The truth would only emerge next time he tried to start the motor on a cold morning. The air choke is there for just such an occasion.

In a one-valve or two-valve set — or in most of them — the RF choke is included in series with the detector plate lead to prevent the RF component from being absorbed in the audio-transformer or the phones or the speaker, as the case may be. Instead, it is fed back into the grid circuit to produce the much-desired "reaction."

Whether the choke is necessary or not depends on such things as the length of the associated wiring, the tendency for the transformer, &c., to absorb RF, and also the amount of RF feedback the detector requires to produce enough reaction.

All these are random, or at least variable quantities, so that the omission of the choke may mean nothing in one set but everything in another.

The same remarks go for some by-pass condensers which may appear to be unnecessary in a particular set. Yet, in another similar set, omission of the condenser may cause it to oscillate, due to accidental regenerative effects, differences in the wiring, and so on.

In the face of this, what is the poor designer to do? I'm afraid there's only one answer, Tom. He specifies the combination of components which experience has shown necessary to ensure uniform performance from one set to another. In odd cases it may cost you a couple of shillings extra, but that's a lot better than taking risks with the design and having you build a set that maybe won't work.

That choke in your car is largely an ornament in summer, but it's still a mighty important little gadget on a winter's morning.

What is a discriminator transformer?

The discriminator transformer is a very necessary item in a receiver intended for frequency modulation, better known by its initials—FM.

An ordinary AM detector does not respond normally to variations in frequency, and engineers have had to devise detector circuits which do. There are quite a few of them, but the first and best-known is the Foster-Seeley Discriminator. Next on the list is the ratio detector.

Both of these require to be fed from a special type of intermediate frequency transformer, which has a balanced full-wave secondary winding and, in some cases, a small tertiary winding as well.

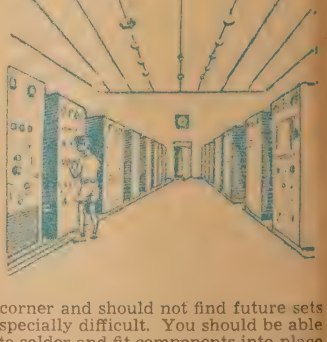
Since this special transformer is intended for use with an FM discriminator, it has thus far gone by the name of "discriminator transformer." That reasoning should be pretty easy to follow.

Physically, a discriminator transformer looks just like an ordinary IF transformer, being round, square or upside down, according to the ideas of the manufacturer. They are usually made to operate around about 10 Mc., which is a common intermediate frequency for FM receivers.

My latest set was the "Minivox." Do you think I could tackle the "Little General" successfully.

Tom, my boy, you could tackle anything. Whether you could make a success of it is another matter.

Seriously, though, if you have successfully built the "Minivox," and got it going well, you have rounded the



corner and should not find future sets specially difficult. You should be able to solder and fit components into place and should have a good idea of what goes as far as valve and coil connections are concerned.

It's certain that you will very soon want to try your hand at a superhet. receiver, and the "Little General" is about the simplest one possible. Once you've built this and lined it up, 5 and 6-valve sets will be a cinch — well, almost!

Get the circuit in front of you and refer to the wiring diagram as necessary. Make every joint clean and permanent and plan ahead so that the wiring parts will be ordered and firm. Check it over carefully before switching on.

You may feel "dicky" about the business of alignment. Tom, but it shouldn't be too hard if you follow the instructions carefully. Some of our older construction articles carried alignment details, but, if these are not to hand, we can let you have a pamphlet on alignment procedure through the shilling query service.

What is an autodyne, a neutrodyne and a heterodyne?

Boy, oh boy, by the time we get through that lot we'll just about be "dyne" on our feet. Hope you appreciate puns, Tom.

The term, "dyne," has been pressed into service pretty heavily by the radio fraternity like the famous suffix, "tron." "Dyne" has something to do in ancient languages with force

or power, but goodness only knows where "tron" came from.

"Autodyne" is the name of a special type of frequency changer used in superhet receivers. It was very popular round about 1931-4, before being supplanted for general use by pentagrid converters, octodes, triode hexodes, and other similar valves and circuitry designed especially for the job.

The special point about an autodyne frequency changer is that it is uses an ordinary RF pentode valve like the 24A, 57, 6C6, &c., to quote the types most commonly employed. The valve performed the combined functions of oscillator and mixer and did the job very well on the broadcast band. The disadvantages which spelt its doom were the difficulty of applying gain control, also its limitations in dual-wave receivers.

NEUTRODYNE

The word, "neutrodyne," belongs to an earlier era and describes a general type of circuit.

You remember the old story, Tom, about triodes as RF amplifiers. When a tuned circuit is connected to both grid and plate, a triode goes into oscillation very smartly because of the internal capacitance between the said two electrodes. Nowadays we get over the trouble by using nothing else but pentodes for the job, these valves having very little direct capacitance between grid and plate.

But in the days BP (before pentodes), the only alternatives were to forget the RF amplifier altogether or else restrict its gain.

Then someone had a bright idea. They tapped either the plate or grid coil—either way would work—and fed energy from the plate back into the grid circuit out of phase (or in opposition) to that fed back through the valve capacitance. This was termed neutralisation and a small neutralising condenser was provided so that the two feedback paths could be balanced exactly.

Receivers using neutralised RF stages were referred to under the general name of "neutrodynes." Whether the name had any commercial tie-up we forget—it's quite some time back. You were only a probable statistic in those days, Tom.

Neutralisation, as a principle, isn't used much now in receivers. It is common practice in transmitters, however, and every ham will scowl at the mention of the word.

HETERODYNE

Last, but not least, comes the "heterodyne." This time it isn't a set or a circuit, it's just something that happens.

A heterodyne "happens" when two frequencies beat together and produce other frequencies. In fact, the other frequencies are often referred to as heterodyne frequencies.

Your own one valve set is an ideal example. Let's say you are attempting to tune a station on 1000 kc, and that, accidentally, the detector is left oscillating. As you tune over the station, the frequency produced by the oscillating detector passes over that of the station and produces an audible beat note or a "heterodyne" whistle, which is heard in the phones.

For example, at a particular instant, the detector may be oscillating at 1001 kc, and this beats with the 1000 kc station signal to produce a 1kc heterodyne whistle.

Heterodynes are not always in the audible range, but they are produced when two or more frequencies are fed simultaneously into a non-linear device—for example the detector in a radio set.

A superheterodyne receiver has its own oscillator for generating a local signal, also a mixer where the heterodyne effect takes place. We won't go any further than that, Tom, but the derivation of the name, "superheterodyne," for this class of receiver is obvious.

What wave-length does FM and television use and can American television programmes be received in Australia?

Nowadays, the idea of talking in wave-lengths is being dropped gradually in favor of frequency, expressed in so many kc or mc (kilocycles or megacycles). Some of the older hands admittedly have to do a bit of lightning mental arithmetic to adapt their thinking on occasions, but megacycles are much easier to think in when FM and television stations are the subject of the day.

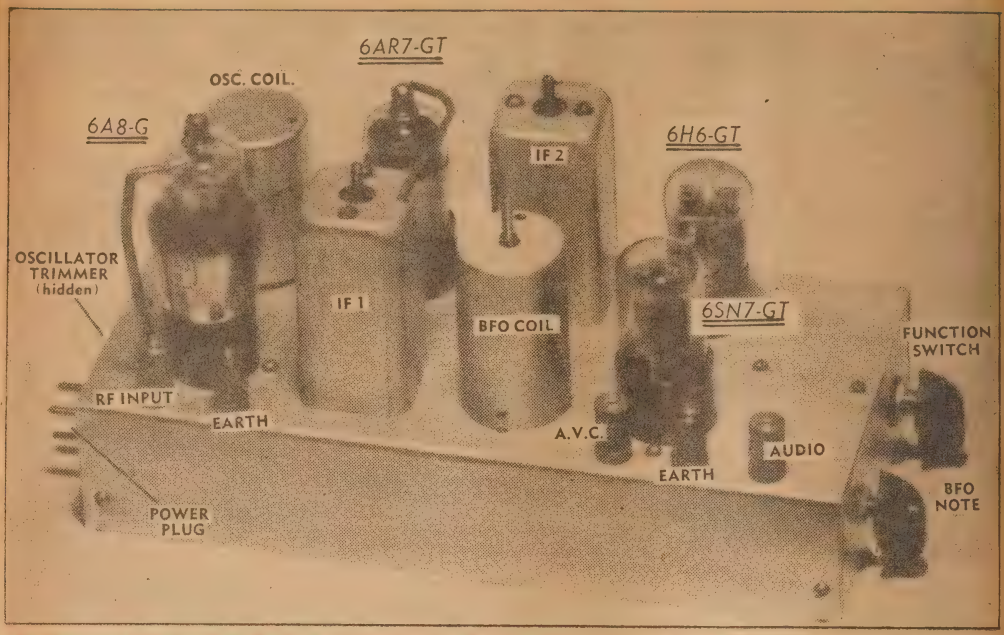
FM stations are ranged between 88 and 108 mc, corresponding respectively to 3.4 and 2.8 metres, to quote round figures. Television stations are given spot frequencies between 55 mc (5.5 metres) and 200 mc (1.5 metres) —all these figures being approximate. It is obviously easier to quote a round number of megacycles than to specify wavelength to a couple of decimal places, as would be necessary.

Normally, signals in this part of the spectrum are limited to little more than visual range—say a radius of 40 or 50 miles at the outside. They may travel beyond this, however, up to a couple of hundred miles under special atmospheric conditions, which cause the waves to follow the curvature of the earth. This is commonly called temperature inversion. However, Tom, even that couldn't get your US signals to Australia.

The only way they can come is by chance conditions in the ionosphere, which cause the waves to be reflected back to earth at a remote point. For the signals to get halfway round the world, this reflection business has to occur several times and the clouds of charged reflecting particles have to be in just the right place at the right time.

On very rare occasions, therefore, some of the lower frequency American television signals may land in your backyard. You'll never know, however, unless you have an American receiver on American transmission standards all poised and waiting.

You'd have a better chance of winning the lottery and go find the signals rather than wait for them to find you.



This photograph was taken with the 175 kcs transformers in place. Transformers at 100 kcs. or 50 kcs. can also be used where extremely good selectivity is required. The optimum layout depends on the receiver with which the unit is to be used and we suggest that you arrange the components to suit your particular case. Aim to keep the function switch and B.F.O. note controls easily accessible and the connecting leads short.

AN "OUTBOARD" I.F. CHANNEL

This outboard I.F. channel can give knife-edge selectivity to your existing set. The unit is self-contained and can be attached to the parent receiver without extensive changes to the wiring. As an added attraction, the unit includes an extremely effective noise limiter and B.F.O. circuit.

by Maurice Findlay

THE congested conditions on the high frequency bands at the present time are a challenge to even the best receivers. In most cases, their performance would greatly benefit by increased selectivity. Some commercial receivers include crystal filters but experienced experimenters agree that these have serious disadvantages.

Crystal filters are difficult to adjust in operation, tend to "ring" on pulses of noise and the peak at the nose of the curve is usually too sharp for satisfactory phone reception, even in the least selective position of the filter.

But it is a big job, both from the point of view of time and expense to construct a special receiver using highly selective I.F. transformers or a special double superhet. Furthermore, many enthusiasts have receivers which have given smooth and efficient service over a period of years and which they do not wish to discard. If an expensive commercial receiver is involved, many enthusiasts prefer not to interfere with it.

With these points in mind, we set out to develop a flexible design for an "outboard" low frequency I.F. stage, together with a suitable frequency converter.

The receiver proper and the outboard I.F. amplifier go to make up a double superhet receiver. The first I.F. channel is that of the normal receiver while the second channel provides the additional selectivity.

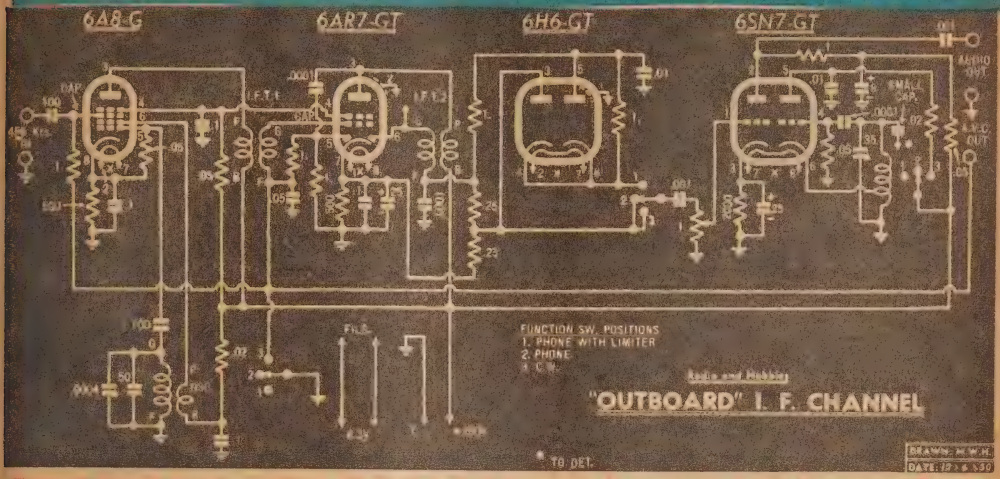
At the moment, I.F. transformers at frequencies of 175 kcs, 100 kcs, and 50 kcs, are available as standard lines from manufacturers.

RELATIVE SELECTIVITY

A single stage at 175 kcs, gives a considerable improvement in selectivity when used with the usual 455 kcs in a double superhet. The response curve for a 175 kcs channel is about 26db down at 5 kcs off resonance, compared with about 22 db for two stages using standard I.F. transformers at 455 kcs. Thus, with the double superhet, with two stages at 455 kcs and one at 175 kcs, the total selectivity is such as to attenuate an interfering signal 5 kcs off resonance by something around 50 db.

This is an excellent compromise between selectivity and quality, where the receiver is to be used for

SCHEMATIC CIRCUIT OF OUTBOARD I.F. CHANNEL



The circuit does not present any problems, either in the matter of non-standard components or physical construction. The combined series and shunt noise limiter is an especially valuable feature. The B.F.O. is optional, depending on the use to which the unit is to be put. Circuit changes for 50 kc. I.F. transformers are detailed in the text.

listening to phone stations, or where there is any doubt about the frequency stability of the basic receiver.

We have, however, included a B.F.O. as an optional feature in the 175 kcs unit, since it is very valuable for locating weak phone stations. In addition, an operator never knows when an emergency will arise which requires code signals to be received. Actually the receiver's normal B.F.O. can be used, if it has one. However, the strength of the beat signal may not be optimum, especially if a high beat note is required. Therefore, for best "single signal" CW reception it is desirable to feed the beat signal directly into the final detector.

If you do not wish to include a B.F.O., the second section of the 6SN7-GT may be ignored or, alternatively, you could use a 6J5-GT or other similar general purpose triode for the audio stage.

There are a few points of interest about the circuit. You will note that the audio coupling condensers are somewhat smaller than it is conventional to use. The purpose of this is to attenuate the bass. The treble is already attenuated, because of the sideband cutting, and if full bass response is permitted, the audio sounds very "woofy."

EFFECTIVE LIMITER

The overall effect when both bass and treble are attenuated is to make the signals sound like anything but high fidelity. Readers will be reminded of the sounds which used to emanate from sets back in the early 1930's, when speaker and audio transformer response characteristics were not very good. However, the overall result is a big impovement in intellegibility when copying a signal which is being interfered with.

The noise-limiter circuit, also, may seem unfamiliar. Tracing through the circuit, you will see that it is a combination series-and-shunt diode-limiter, the operating point of which is controlled automatically to suit the strength of the incoming signal. We have been in the practice of using the series-limiter only in communications type receivers, since the shunt-limiter is not as effective. However, since the extra diode is available and no extra components are required, its inclusion here is worthwhile.

In practice, the limiter is extremely effective, making it possible to read signals which would be otherwise completely masked by noise. Noise peaks tend to be accentuated when high selectivity is employed, making the limiter particularly valuable in this unit.

FUNCTION SWITCH

We have included a function switch which provides a position for phone with the limiter in circuit, a second phone position without the limiter, and a third position for CW reception. The limiter does tend to affect the audio quality somewhat, especially where high modulation percentages are involved, hence the desirability of being able to switch it out.

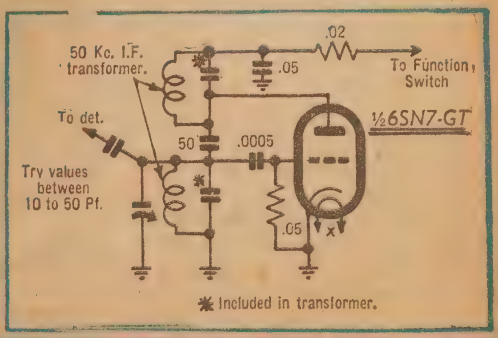
In the CW position, the limiter is disconnected, since it is not particularly effective with the BFO on. The AVC circuit is rendered inoperative also. It is unlikely that you will wish to receive phone signals with the AVC inoperative, and it is undesirable to use AVC for CW.

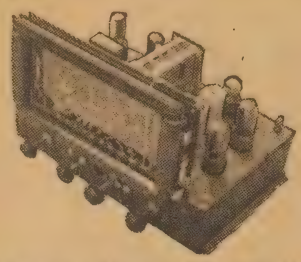
OPTIONAL FEATURES

The AVC for the RF and IF stages of the receiver proper should be taken from the outboard unit, and we have provided a terminal for this purpose. If the normal AVC system is permitted to control the gain of the receiver, strong signals, near in frequency to the required signal, will reduce its sensitivity and part of the benefit of the high selectivity will be lost.

The 6AR7-GT stage is conventional, except that it operates in a slightly overbiased condition. The same applies to the frequency converter. Full gain is not required, and all that is necessary is to compensate for losses in the input circuit. If, in your particular case, the overall RF gain

A 50 kcs. B.F.O. may be constructed with a 50 kc. I.F. transformer should a special B.F.O. coil be unavailable.





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The cadmium plated chassis has been manufactured to exact proportions, so as to dispense with drilling and cutting during assembly. All necessary earth lugs have been punched into the chassis.

Detailed instructions and blueprints of circuit and wiring diagram, are supplied with each kit, which is complete right down to the last nut and bolt.

High grade components only, with the required power and voltage ratings are employed. All components are thoroughly tested before packing. Owing to careful layout of components the receiver is free from any form of instability and no difficulty should be encountered in getting satisfactory results.

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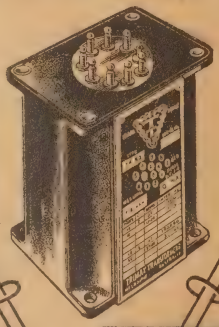

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proves to be insufficient, either or both of these resistors could be reduced to a minimum of about 300 ohms.

No provision for manual gain control of the 6A8-G and 6AR7-GT for CW reception is made. The manual gain control in the receiver will normally be sufficient. However, if your receiver does not include a manual gain control it would be a perfectly practical scheme to include one on the chassis of the outboard unit.

Use a connecting plug which provides for an extra wire, and after suitable bypassing return the appropriate cathodes to the potentiometer through the connecting cable. In most cases a potentiometer having a resistance of about 20,000 ohms would be suitable. It would be necessary to make the chassis a little larger than our original to accommodate the extra control.

AUDIO STABILITY

The audio gain control shown in the circuit is optional. Actually we used a resistance divider network proportioned so that the 6SN7-GT did not overload on strong signals and which at the same time provided sufficient gain. The design we have suggested will satisfy most requirements. In some cases the full gain of the triode section will be required, while other receivers with high audio gain may even operate successfully with the audio amplifier omitted altogether.

There is an audio decoupling network in the plate circuit of the adiuo voltage amplifier. Its purpose is to prevent low frequency oscillation, or "motorboating," due to coupling through the high-tension supply.

Both the circuit and the photographs are of the unit using 175 kc IF transformers. However, we also conducted some experiments with a set of 50 kc transformers.

The particular transformers we used have a fairly high Q factor combined with low coupling between the windings. With a single stage using two transformers the selectivity is such that a signal 1.5 to 2 kcs. from the resonance point is virtually eliminated.

BANDSPREAD REQUIRED

Selectivity of this order is valuable for working on crowded amateur bands, particularly in the CW sections. Although the audio quality is poor, due to the lack of treble, the unit using 50 kc. IF transformers is valuable for phone working also.

We have noted by listening tests that best results are achieved if the receiver is tuned slightly off resonance, so that the carrier is attenuated slightly and more modulation on one or other side of the carrier allowed to pass. Most of the hetrodyne interference from adjacent stations is eliminated. If there is an interfering signal slightly higher in frequency than the desired signal, best results can be achieved by tuning the receiver slightly lower in frequency than the desired signal, and vice versa. The extremely good selectivity makes it possible to copy many more stations through hetrodyne interference than would otherwise be possible.

We do not suggest that any attempt be made to use the 50 kc channel with an ordinary dual wave receiver. The amount of bandspread available is insufficient to allow reasonably easy tuning. Even with the 175 kc. IF's, the tuning is likely to be more critical than is comfortable if the receiver covers a tuning range of anything like the usual three to one. However, if you have a stable all wave receiver with a reasonable amount of bandspread, the 175 kc. unit can be used to advantage.

With amateur receivers it is not uncommon to have a 180 degree vernier dial covering only about half a megacycle, in which case comfortable tuning is possible, even though the bandwidth is less than a couple of kcs.

It will not be hard to realise, of course, that such high selectivity imposes very rigid requirements on both receiver and transmitter stability, and in many cases it may be necessary to spend some time making the high frequency oscillator section of the receiver stable, mechanically by making sure that all components are rigid, and electrically by judicious use of zero temperature coefficient condensers, &c.

We have not as yet had an opportunity to test the 100 kc. transformers, but it would appear that they would be excellent where an intermediate degree of selectivity is required.

After having assembled the unit the important job is to bring the oscillator section of the converter valve to the correct frequency. With a 455 kc. first IF channel, this is 630 kcs.; if you are using the 175 kc. transformers and 505 kcs. for the 50 kc. transformers.

ADJUSTING OSCILLATOR

We used a standard broadcast band type oscillator coil, and in each case paralleled sufficient capacitance to bring the oscillator down to the desired frequency. Incidentally, the coil has an iron core which allows some ocntrol over its inductance.

To reach 630 kcs. we paralleled the coil with a 50 pf. fixed mica condenser, and also a broadcast band type variable padder with a maximum capacitance of about 400 pf. The latter is used to check the adjustment occasionally in service. Under these circumstances, 630 kcs. will be reached with the padder at almost full capacitance, and the slug almost fully in the coil.

The 505 kc. setting for the more selective IF may be reached with the 250 pf. fixed mica condenser in parallel with the coil, in addition to the padder, and slightly less inductance than in the previous case.

If you have access to a calibrated signal generator, it is possible to find the correct frequencies by direct means. The idea is to place a temporary audio load in the plate circuit of the mixer and with a pair of headphones, listen to the beat note between the oscillator and the generator. The latter is loosely coupled into the mixer.

The audio load can consist of a resistor of anything from 10,000 ohms to .1 megohm, and is inserted in the plate circuit of the converter, either between the plate and the IF transformer, or between the transformer and the high tension line, depending on which connection happens to be the more convenient in your particular case. A condenser of about .01 mfd. is connected to the "hot" side of the load.

Attach the phones between the other terminal of the condenser and earth.

ALTERNATIVE VALVES

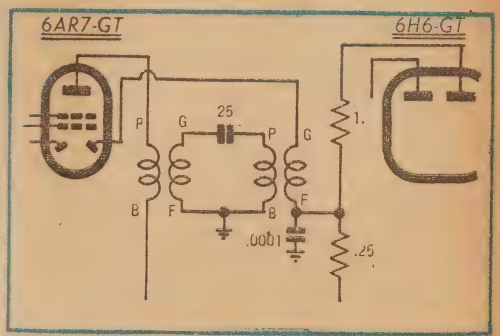
The signal generator may be fed into the grid of the mixer and adjusted until it is possible to hear a beat note. Tune for zero beat and the generator dial will indicate the frequency of the local oscillator.

Incidentally, there is a wide choice of valve types which may be used in the mixer socket. We used a 6A8-G simply because it happened to be on hand. A 6J8-G, 6K8-G, ECH35, or X6IM may be used in place of the 6A8-G. All will work without circuit changes, but if you use another type for the converter it may be as well to check with a valve data book regarding the correct oscillator plate and screen voltages. Type 6SA7-GT may also be used if an oscillator coil suitable for it is provided. A 6G8-G may be used instead of the 6AR7-GT if desired.

Having set the oscillator on the correct frequency it should be pos-

(Continued on Page 87)

Three 175 kc transformers can be used to gain additional selectivity if desired. A larger chassis than the original will be necesasry to accomodate the extra hole.



FROM THE SERVICEMAN WHO TELLS

While some folks have a natural and a healthy respect for power leads and connections, others treat them with complete nonchalance. Most servicemen have seen numerous examples of both classes, but I am in the advantageous position of being "The serviceman who tells . . ."

SOME may challenge my right to discourse on such a topic, but I can advance three very good reasons for so doing:—

1. I may be able to caution some careless person.

2. Electrical connections have a bearing on radio performance, and—

3. It gives me something new to write about!

The above reasons are not necessarily set out in order of importance.

Thanks to new houses, new fittings and a degree of enlightenment, the proportion of really dangerous installations is probably much lower than it used to be, but the need for care has not diminished.

TINGLING TOASTER

Half-way through a service job on a radio, the lady of the house mentioned that she got "tingling feelings" from the toaster. Perhaps there was something wrong with it?

There certainly was. Just up near the top of the element, the resistance wire had sprung out of the retaining slot and welded itself to the metal framework, making the whole thing very much alive.

Accidents like that have happened before, but here's the point—or, rather, there was the point! Yes, the proper power point was round the corner of an archway and hubby or someone had rigged up an extension which plugged into the original point and led the power round to a switch and socket right above the breakfast table.

However, he had not bothered to extend the earth wiring, so that the frame of the toaster simply became alive when the internal fault occurred. Had the earthing system been intact, part of the element would have lit up brightly for a few minutes, then burnt out—thereby calling attention to the short. There never would have been any danger to the user.

A rather parallel case occurred recently with an iron which developed an internal short and produced "tingling effects." This time the power point was in order, but the connection had been made to it by two-way cord. Fortunately, mother had not touched the tap and the iron at the same time or the job of ironing may have fallen to father from then on.

I don't like broken fittings either. I had to service a small mantel set a few months ago, operating from the light socket in a room. This isn't dangerous in itself, although a separate power point for the radio is to be preferred.

However, when I reached up, in this case to withdraw the bayonet plug for the radio, I got a handful of 240. The top of the ampholder was cracked enough to expose the brass terminals inside.

Another one of my pet aversions is perished power cord, and this is especially prevalent on old radio sets. Often enough the set is only moved once in a blue moon and the rubber has every chance to get hard and brittle. The first time the cord is subjected to strain or movement, the rubber cracks and only the half-perished cotton is left to protect the wires.

It's impossible to connect such stuff satisfactorily to a fitting. There's only one way to repair such cord—throw it in the fire and buy a new piece! What's that story about Paddy's gun?

However, all these observations and experiences pale before the efforts of a genius in one of Sydney's eastern suburbs. Wishing to move the radio he was faced with the need of bringing the power from one side of the room to the other.

Nothing daunted, he searched round and located a roll of single-cotton covered wire of the type which has since been discarded even for electric bells. Next "find" was a bottle of tacks, and these were driven into the skirting board, ever so neatly in rows about an inch apart. The wire was duly run from tack to tack, terminated at each end and wired as an extension to the 240-volt power mains.

SOLID CONNECTIONS

Fortunately, your humble serviceman arrived on the scene on another errand before our friend had blown either the fuses or himself.

But enough of the safety angle. From the point of view of reception, it is most important to see that the power connections to the radio particularly are solid and firm—if one may double up on adjectives. Loose-fitting power plugs, faulty switch contacts and so on give rise to a variety of sizzles and bangs—and service calls.

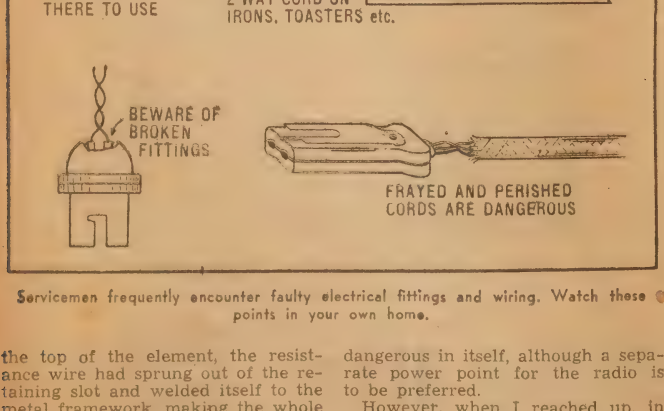
One should be able to wiggle the power cord, wriggle the switch and bump the power socket without the slightest protest from the radio. If it does make noises when you do these things, you can be sure that a troublesome loose contact is present or on the way.

A couple of months ago, a client came along with the complaint that the refrigerator was causing a lot of noise in the radio. . . . Yes, it was an electric model, not gas or kerosene!

An inspection revealed nothing wrong with the frig. or the switches. I checked everything pretty carefully but, since there was nothing to be done, I didn't do it.

FAULTY FUSE

Later, the noise was reported again, and evidence advanced to convince me that the frig. was the culprit beyond all doubt. Before I got a chance to make the next visit I received a further call with the interesting information that a slight buzzing noise could be heard near the meters. Yes,



Servicemen frequently encounter faulty electrical fittings and wiring. Watch these points in your own home.

you've guessed it—a loose fuse on the switchboard.

Then there was another instance of a little old lady with a little old set, which was loud sometimes and not so loud on others. Sometimes she had to turn it right up, at other times it was just as loud when turned right back.

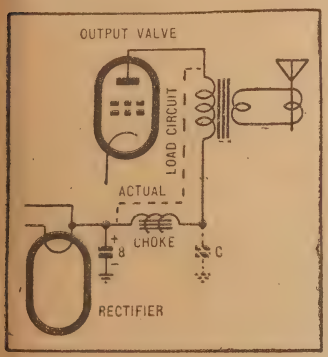
To cut a long story short, the set was a simple affair with manual gain control, no earth and very little aerial. It was switched on and off by plugging in or out of a two-way adaptor in the light socket. What the old lady hadn't realised was that the set performed better for some unknown reason with the plug in a particular way. It was a matter of pure chance which way round it went in.

Strange effects like this often happen with a-c receivers, if used with a small aerial. Volume is likely to vary when switches are operated, appliances plugged in, and so on. Fortunately, perhaps, the effects are largely overcome in modern receivers by the operation of the AVC circuit.

GOOD AERIALS

With no earth and only a very small aerial, the signal tends to arrive at the first grid via the power wiring, what there is of an aerial, and the capacitance effects to earth. When the power circuits are modified by operating switches, appliances and so on, the signal pickup is likely to be affected, in some cases enough to vary the volume from the speaker to a marked degree.

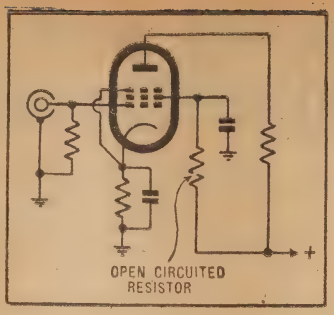
Most sets operate quite satisfactorily, these days, with a primitive aerial and earth system (in the suburbs, anyway), and there may not be much argument in favor of



Apart from its job of filtering, the final 8 mfd. condenser in a set forms the audio return path for the output circuit. Low capacitance results in reduced power and high distortion.

big poles in the backyard. But, if signals do vary in strength, see if the variations can be related to electrical goings-on. If so, try the effect of a bigger aerial and an earth wire.

Looking back, I am very much afraid that what was intended as an introduction has grown into the major part of the article. However, if my remarks have served to make someone more careful or to direct attention to faulty equipment, some good purpose will have been served.



An open-circuited screen resistor drops the gain of a pentode amplifier without actually rendering it inoperative. Plate resistors occasionally fail also, with similar results.

Only yesterday, I had a job which was rather unusual for a city serviceman, namely to attend to a vibrator set at short notice. It belonged to a couple who had originally owned a caravan. When this had been sold, the radio was retained and operated as a bedroom set from the original accumulator. A trickle charger kept the battery in some sort of condition. Anyhow, strange or otherwise, both set and battery were delivered to me for attention.

The first job was to get rid of the usual thick layer of dust, then repair the dial movement. A spot of oil on the control shafts stopped other sundry squeaks and the set was thereafter ready to switch on.

VIBRATOR REPAIR

Its performance was pretty poor, volume low, sensitivity low and distortion high. It turned out that the high tension voltage was less than 70 and, since the vibrator was apparently an old one, it was immediately suspect.

Not having a replacement on hand, I slipped the vibrator out of its cartridge and had a look at it. There was plenty of soot about, but the contacts did not appear to be burnt much—certainly not charred and pitted as I had seen some.

The soot was wiped away and a strip of fine emery paper run be-

tween the contacts both ways and on both sides. Then followed a piece of cloth to get rid of the emery particles.

I then put the vibrator back in its socket without the case, clipped a meter across the HT line and switched on. The voltage was now up to 90 odd, which was still low.

Remembering an old trick, I gingerly held the tip of a bakelite lining tool first against one secondary contact then the other. Likewise the primary contacts. The operation on one secondary contact in particular made a big difference in the output voltage, indicating that the gap was apparently far too wide. I bent the contact in a trifle, so that it appeared to be closing just a "whisker" after the adjacent primary contact. The volts? Up to 110 or thereabouts.

Next operation was to check the input and here two sources of loss were discovered. The battery itself was reading just over 5.0 volts, while there was a drop of about a quarter volt across the fuse. This latter was traced to the contacts between the fuse and holder and a rub with emery paper quickly put it right.

Not having another battery on hand—I am just a humble city serviceman—I had to be content with the knowledge that the performance of the receiver should now be reasonably good, though it would obviously be a lot better with the addition of a new battery.

In point of fact, however, the reproduction was far below acceptable standards, being both distorted and thin. There was also a solid background of hum behind all stations.

More with the hum in mind than anything else, I connected an 8 mfd. condenser between the HT line and earth and noticed immediately that the reproduction cleared up. The bass reappeared, output increased and the quality improved out of sight. Ah, yes, this was the old story.

In any receiver employing a filter network—and this covers all a-c and vibrator sets—the final filter condenser forms the return path for the audio output circuit. Let this condenser diminish in value and the audio energy begins to divide into the filter choke as well as the output transformer, the process beginning at the bass end, because the residual capacitance of the final filter condenser may initially be enough to bypass the middle and upper frequencies and keep them in their place.

NEW ELECTROLYTIC

A new 8 mfd. filter condenser was duly installed, but it did not clear up the hum. Then I noticed that the hum was apparent only when the set was tuned to a station. In other words, it was a clear case of modulation hum. This looked like the filament network.

Luckily, I had a couple of 400 mfd. electrolytics on the shelf, and one of these on the filament line wiped the hum in no uncertain fashion. It was simply a case of all the electrolytics drying out after years of service.

The valves? They were apparently as good as ever.

I had to look at another guitar amplifier this week. It seems that every second beau these days is learning to pluck the strings. We never had to go to such lengths when I was young to attract the girls!

Anyhow, this amplifier was very weak and obviously distorted on the louder bass strings. Admittedly a very serious circumstance in a modern electronic courtship.

THE CAUSE

Volts okay. Valves okay. Speaker okay. Must be the voltage amplifier stage. A pentode? Ah, the screen resistor!

Yes, the 2.0 meg. screen resistor was as open as the prairies and the volts as low as my charges! Ahem! Cheap resistors may be all right up to a couple of hundred thousand ohms, but over that—nothing but the best.

TRADE REVIEWS AND RELEASES

A NOISE GENERATOR DIODE

Amalgamated Wireless Valve Company announce the release of a new H.F. diode valve intended to be used as a noise generator for checking the noise factor in receivers.

THIS new valve, designated type A1468, should fill a long-felt want by engineers. It is a diode incorporating a directly heated tungsten cathode and is particularly suitable for use as a noise generator. Only a very simple type of circuit is required.

In addition, the valve can also be used with very satisfactory results in bridge-type regulated power supplies as a saturated diode in one of the bridge arms.

The valve is mounted on the standard English 9-pin base, as used on EF50 and similar types. The maximum filament voltage is seven and, with six volts applied, the filament has a current drain of one amp.

Saturation plate current is 30 mA for a filament voltage of from 6.25 to 6.75 volts and 18 mA for a filament voltage of six volts. The plate to filament capacitance is 1.2 pF and the seated height of the valve 2 7-16in with a diameter of 1⅛in.

Stocks of this valve are now available on order. Its price has not yet been determined but will be somewhat higher than the price of normal receiving valves. (Amalgamated Wireless Valve Co. Pty. Ltd., 47 York Street, Sydney.)

BOOK REVIEW

Plastics in Handicraft, by P. W. Blandford. Hard cover, 167 pages, fully illustrated.

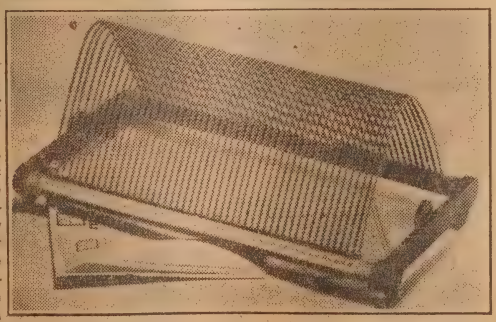
This book contains a wealth of valuable information for the craftwork teacher and for those who, in their own homes, like to make things from plastic.

It gives a very complete treatment of the various methods of machining and shaping most of the more popular plastics, together with many diagrams and illustrations of things to make. Some of the projects, in the author's experience, have been made by lads from 11-16 years.

Some of the many chapters are titled as follows: What are plastics?—Properties of various plastics.—Manipulation.—Plastic work as a school craft.—&c. . . . The book gives a list of the necessary hand tools required to perform simple operations and also the best method of machining and finishing the jobs. A goodly proportion of the total space is taken up by excellent illustrations and photographs.

The book is available from most technical book shops and its Australian price is 23/6 approx. (D.A.W.)

NEW MODEL OF "PLATTERACK"



Illustrated above is the new and improved version of the "Platterack" record holder. It is fitted with plastic end pieces and the record holding assembly is heavily sprayed with a soft flock to protect the records from damage. The rack can be obtained in a variety of colours and is supplied with an index card and 50 numbered stickers which are attached to the records to identify them.

The "Platterack" retails for 25/- and is available from all leading music stores or direct from the manufacturers, Fred A. Falk and Co of 28 King St., Rockdale.

NEW LINE OF RESISTORS, POTS.

Morganite components have announced the release of a complete range of ½ and 1-watt resistors and standard radio potentiometers.

THE resistors are moulded from carbon and resinous bonds into the form of a solid rod and the leads are actually moulded into the resistor. This construction gives lightweight components of high power dissipation. The resistors are claimed to be very stable with changes in temperature, voltage and humidity and have a low noise level.

They are available in the normal 5 pc, 10 pc, and 20 pc tolerances with special values to order.

The potentiometers are of small physical dimensions being 1 1-8" in diameter and projecting 1¼" behind the panel for the switch types.

The control is fitted with the standard ⅜" diameter 32 T.P.I. bush and appropriate nut.

The potentiometers can be obtained with or without a switch, the latter being either a double pole or a single pole type as required.

The switch is rated at 240 volts 2 amps or 12 volts 12 amps and manufacturer's life tests indicate that the switch will operate satisfactorily for over 20,000 operations.

The controls are available in all standard values from 5000 ohms to 2 megohms with a log, inverse log or a linear law element. The element will dissipate ½ watt continuously at a temperature of 70 degrees Centigrade.

These components will be made available through all the normal radio supply houses. Trade inquiries to The Morgan Crucible Co. (Aust.) Pty. Ltd., Bourke Rd., Alexandria, NSW.

TELEVISION COURSE

A series of lectures on television commenced at the NSW Institute of Technology on April 12. The complete course of 27 lectures costs £5/5/-, or £1/1/- for the first five lectures.

The subjects to be dealt with cover from the economics of television to specialised aerial design and should be most informative to the engineer. The first five lectures are of a general nature but the remainder of the course is purely technical and the lecturers will assume that those attending have a University degree or a Technical College diploma.

It is intended to make television a permanent subject at the NSW Institute of Technology in the future.

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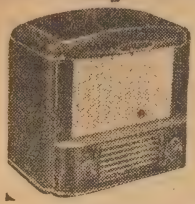
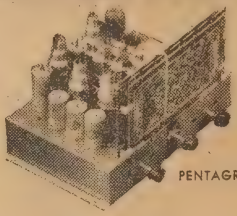
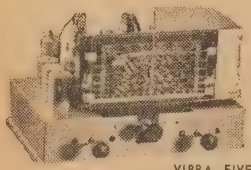


E.P. 3-VALVE TRIPLE WAVE

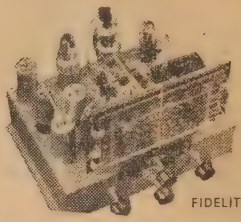


PENTAGRID FIVE

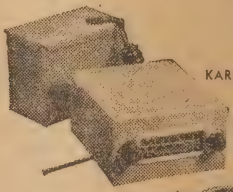
32-VOLT RECEIVER



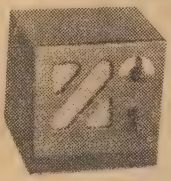
VIBRA FIVE



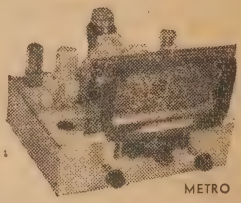
FIDELITY 5



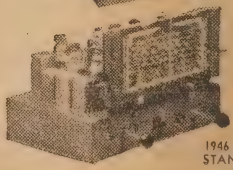
KARSET



INTERCOMM

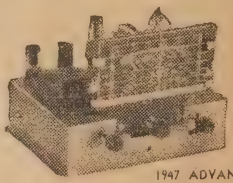


METRO 4



1946 STANDARD

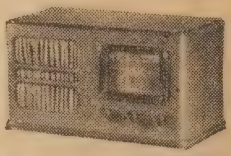
VIBRAGRAM 7



1947 ADVANCE

SLUMBER SET

1950 RADIOGRAM



FIRESIDE 5

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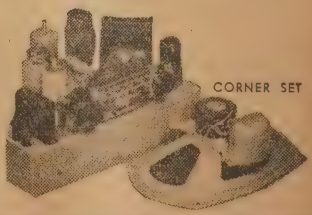
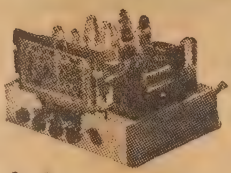


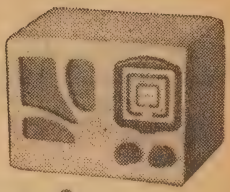
CORNER SET

every possible purpose . . .

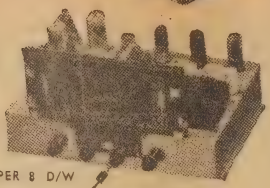
KINGSLEY DESIGNS



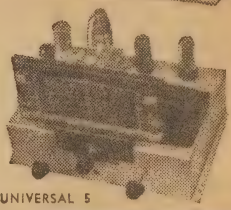
1947 SENIOR OR MAJESTIC RADIOGRAM



LITTLE GENERAL

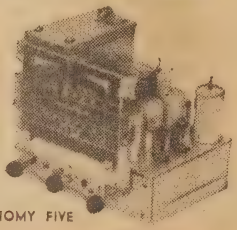


SUPER 8 D/W

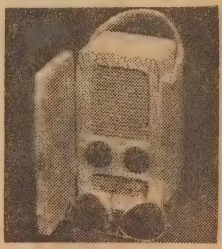


UNIVERSAL 5

SPRINGTIME PORTABLE



ECONOMY FIVE



CARRY SET

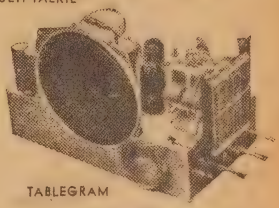
ALL BATTERY 5

SENIOR PORTABLE

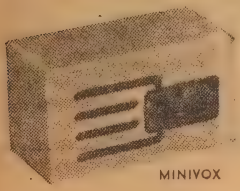
MULTI-TALKIE

6-240

HANDIE TALKIE 4 & 5 VALVE



TABLEGRAM



MINIVOX

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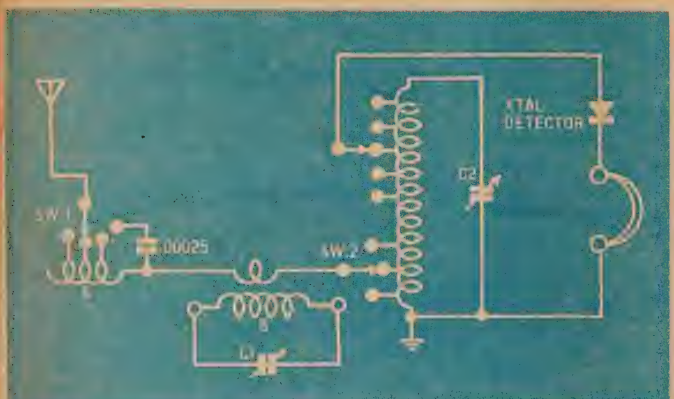
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

ANOTHER CIRCUIT FOR CRYSTAL SET FANS



A recent reference in these columns to American crystal circuits has brought to light yet another circuit which local experimenters may care to try out. Under the name "Flextal", it provides approximate tuning for the aerial circuit and a built-in wavetrap, in addition to the normal tuned circuit.

ORIGINALLY supplied by Mr. M. Schuman, of Maryland, US, it was sent along to Radio and Hobbies by his pen-friend Mr. J. S. Thorn, 2 Railway Street, Cook's Hill, NSW.

Although some of the very powerful US broadcast stations allow unusual results to be obtained in certain locations, their signals make it difficult for crystal sets in other locations owing to their naturally limited selectivity. The "Flextal" circuit has been designed to assist in eliminating interference from powerful local signals.

Coil A is intended to resonate with the aerial, which should be efficient and well erected. Approximate resonance is achieved by rotating a tap switch, the position being selected which gives the loudest signals from the desired station.

The signals then pass through coil B., which forms a wave trap. The tuning condenser is simply adjusted to reduce to a minimum the signal from whatever local station is causing the interference.

From this point onwards, the circuit operates in the normal fashion. The signal is tapped in at the earth end of the coil, and the higher the tapping up the coil, the louder will be the signals. However, selectivity is reduced at the same time and a tapping point must be selected which gives the best balance between the two conflicting factors.

Much the same remarks apply to the tapping point for the crystal, signals becoming louder and the selectivity poorer as the tapping approaches the top of the coil.

Although the process of adjustment may appear complicated at first glance, it does not lead to any special difficulty in use. The set can be tuned up for best results on each station and the switch and condenser settings recorded. After that it is merely a matter of setting the controls according to the tabulated list.

Winding data supplied with the circuit is as follows:—

Coil A. has 63 turns of 20 DCC wound on a 2in diameter former. It is tapped from the circuit end at 3, 7, 12, 18, 23, 33, 42, and 52.

A 10 or 11 point tapping switch for SW1 allows the aerial to be connected to any one of the tappings, to the end of the coil or to the free end of the .00025 condenser.

Coil B., which is the absorption type wave trap, has 115 turns of fine wire—somewhere about 32 B and S enamel—on a 1in diameter former. The smaller winding can be wound over the secondary and comprise 15 turns of some handy thicker gauge.

TUNING CONDENSER

Condenser C1 can be anything between about .00025 and .0005 mfd, the higher value being desirable if the trap has to be tuned to a comparatively low frequency.

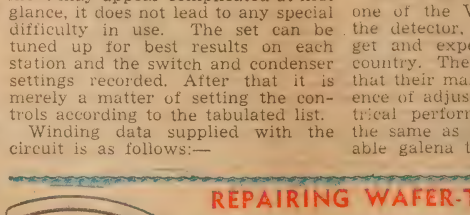
The main tuning coil "C," comprises 99 turns of 20 DCC on a 2in former. It is tapped from the ground end at 3. 6, 10, 15, 27, 39, 51, 63, 75 and 87.

Switch 2, which should have about four positions, operates on the lowest tappings, while switch 3, having about seven positions, operates on the upper end of the coil.

Such is the information given with the circuit. As usual, small changes could be made in the winding or tapping data to suit materials on hand, without upsetting the performance of the set.

American crystal set fans favor one of the VHF crystal diodes for the detector, but these are hard to get and expensive, as yet, in this country. They point out, however, that their main appeal is in permanence of adjustment rather than electrical performance, which is about the same as the best of the adjustable galena types.

REPAIRING WAFER-TYPE SWITCHES



Standard pliers, modified as shown, can be used to tighten the eyelets used to hold the contacts in some types of wafer swithes. The screw, when properly adjusted, will allow the eyelets to be tightened without fear of damage to the wafer.

"TREBLE TROUBLE" IN AMPLIFIERS

(Continued from Page 51)

shows the actual basis of measurement, the shielded wire referred to being of the better quality.

The curves of figure 2 include ordinary circuit capacitances, plus the Miller effect of a pentode—the least critical type of valve.

For purposes of comparison, the solid line, curve A, shows the response which can be expected from a complete input circuit involving an average magnetic pickup, properly loaded, the volume control full-on, and the internal wiring done with low capacitance coaxial cable. The response, limited by capacitive effects only, is down about 1½db. at 15 Kc.—not a very serious figure. With the control full on, the entire shielded input circuit is above earth by only a moderate impedance — the parallel figure of pickup and load.

Turning the control to the centre position, however, raises the grid circuit impedance and drops the response by no less than 7 db. at 15 Kc. (Curve B).

With ordinary shielded wire, curve C, the response in the mid position of the control is down by nearly 8 db, at 10 Kc. and by 13 db. at 15 Kc.

When the Miller effect of a triode is taken into account, the centre-control response becomes even worse. Fig. 3 shows measured results for the same network as above, feeding into three valves—a typical pentode, a general purpose triode and a high-mu triode. The futility of buying expensive wide-range equipment is obvious if from 10 to 15 db. is to be thrown away at the top end in the input circuit.

What then is the answer to the problem? Actually the answers (plural) may be summarised as follows:—

1. Arrange the layout to minimise the need for shielded wiring. Where it must be used in high impedance circuits, go for the low capacitance coaxial type.

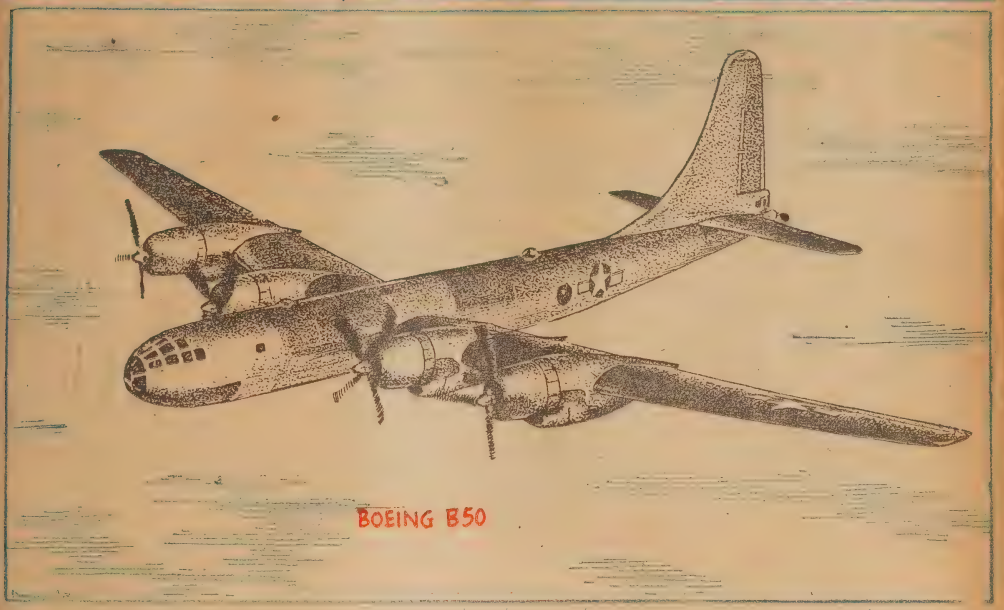
2. External factors may set the volume control resistance but never make it higher than necessary.

3. To avoid Miller effects, use pentode voltage amplifiers rather than triodes, reducing gain if necessary by lowering the plate load and adjusting other conditions to suit.

4. If losses are inevitable at mid-control settings, consider the use of a compensating condenser (see portable recorder circuit on page 29).

One could go into a lot more detail but enough has been said to set the more ambitious fans thinking along the right lines. Where conventional speakers and pickups are used the remarks do not apply with the same force, since the system will tend to roll off in any case between 5 and 7 Kc. Any attempt to reproduce frequencies beyond this must take into account the elusive not-in-the-circuit quantities.

THE SUPERFORT. GETS TOUGHER



In World War II, the Boeing B-29 Superfortress played a notable part in smashing Japanese resistance by carrying the air war right to the heart of the enemy in the Pacific. With tremendous range and great defensive power, Superforts were the spearhead of the attack, and the B-29 design proved to be one of the outstanding developments in military aviation.

AT the end of the war the Boeing B-50, retaining the general characteristics of the B-29, but in fact a "75 per cent new" aircraft, was set down as the successor to the B-29 as the standard heavy bomber in the USAF Strategic Air Command.

Original specifications for a four-engined bomber to succeed the B-17 Flying Fortress were issued by the US War Department early in 1940, but considerable modifications were made a little later to provide for increased armament and greater load requirements. The Boeing company designed Model 341 to meet the original specifications and later modified this into Model 345 to incorporate the further requirements.

HUGE PRODUCTION

After the USA entered the war a vast production programme was put in hand, involving five main production plants and hundreds of sub-contractors. The prototype flew in September, 1942, and production of the B-29 ceased in May, 1946, after a total of 4221 had been built. Modernised B-29's were set down as equipment for the postwar 70 Group Air Force.

Successor to the B-29, the B-50 retains the general characteristics but is so greatly modified as to constitute virtually a new aeroplane.

The wing, fabricated in the new 75-S aluminium alloy, is 16 per cent stronger and 26 per cent more efficient than that of the B-29, yet it weighs 650lb less.

The Wright R-3350-23 motors of the B-29 have been replaced by Pratt and Whitney R-4360's rated at 3500 horsepower each. This has resulted in an overall increase in horsepower of 59 per cent.

The tail fin of the B-50 is five feet higher than that of the B-29. An interesting point is that these vertical tail surfaces are hinged to fold horizontally over the starboard tailplane, so that the B-50 can be housed in existing hangar facilities.

Known as the B-50A, the first production version mounted R-4360 Wasp-Majors fitted with turbo-superchargers and driving four-blade constant-speed full-feathering and reversible airscrews. As well as new and larger tail surfaces the aircraft had lighter wings than the B-29, together with lighter-weight landing gear with quick-retracting mechanism.

Other models, full details of which have not been released, include:

- The B-50B, incorporating certain structural changes;
- The YB-50C, fitted with R-4360-VDT supercharged and compounded engines, reducing fuel consumption and so permitting increased range up to 30 per cent, and incorporating also changes in configuration, armament and crew arrangement; and
- The B-50D, a production type in which changes in radar installation and crew arrangement are incorporated.

SIMILAR TO B-29

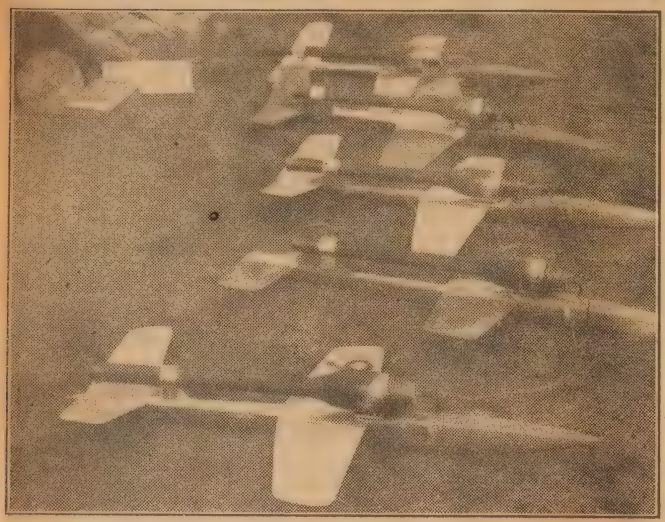
Taken generally, the B-50 follows the layout of the B-29, being a mid-wing cantilever monoplane with a fuselage of circular section semi-monocoque structure in five sections.

Accommodation was provided in the B-29 for a crew of from 10 to 14. Normally the crew consists of pilot, co-pilot, navigator, bomb aimer, engineer, radio-operator and four gun-control operators.

The forward pressurised compartment accommodates the bomb-aimer, pilot and co-pilot side-by-side with an aisle between; navigator facing forward behind the pilot; engineer facing aft behind the co-pilot; and radio-operator behind the engineer.

A crawl-tunnel over the bomb bays connects the forward compartment with a second pressurised com-

JET POWER FOR MODEL PLANES



A line-up of jet-powered model aircraft at a recent rally at Radlett, England.

Considerable interest is being displayed overseas in models powered by rocket and jet motors. While these have not yet appeared in great numbers in Australia, these observations by C. E. Bowden, A.I.Mech.E., an English flyer, will be of interest to local enthusiasts.

MILITARY aircraft are rapidly becoming jet-powered and there are a number of airliners flying with jet engines. This development is not surprising when it is considered how fundamentally more simple a jet engine is than the reciprocating type.

Both employ internal combustion, but the jet engine eliminates many moving parts, besides getting away from that limiting factor of the propeller at speeds approximately 450 mph and over.

Furthermore, a jet engine has no torque reaction. This latter point is most important from the aero modeller's angle, for at least 80 per cent of crashes are due to the upsetting forces of propeller torque. It is simple to design a model glider to have great stability, but as soon as an engine with its propeller is added, stability problems occur.

LARGE PLANES

Apart from this advantage of jet propulsion for models, the fact that full-sized craft will mostly be flying by jet propulsion in the next few years, is bound to cause the modeller to follow suit.

Unfortunately, there are at the moment certain limitations, for the model jet engine has lagged behind its full-sized brother, not so much in efficiency, but in a useful size and power output to suit restricted flying conditions.

Most of the model jet units of the internal combustion type, as opposed to rocket, are very powerful and noisy. The power is so great that even control-line flying can be dangerous to spectators if the operators are not careful about the strength of lines and so on.

This is, however, a matter of development, and the fact must be faced that whatever obstacles are placed in its way, the jet is the coming power unit and cannot be suppressed. The old "red flag" failed to stop the motor car and motor cycle. It should not be difficult to encourage a suitable low-powered jet engine, apart from the rocket type, by sensible association rules.

There are one or two ventures at the moment which will doubtless provide smaller and less powerful jet motors in the future.

Our present British engines have developed from the very powerful American jet motors, and all at present offer over 3½lb static thrust, which builds up to greater thrust due to ram effect as the model flies faster. Such a thrust is vastly more than we require, except for racing speeds in control-line flight, when a record is being sought.

This ultimate speed craze has evidently appealed to the Americans, who have put the world's speed record for control-line flying model engine aircraft up to over 170 mph by a jet engine.

When we consider that the most popular sized piston reciprocating (propeller) engine in Britain today is the diesel, having a thrust of approximately 15 to 20oz, it will be clear what I mean. Such a thrust suits our model purposes in general.

Greater thrusts are required for models of the large type and also for radio-control models, but it has been found that the average young man is best suited by the lower-powered engines, and this in my opinion is the power that the jet engine should be designed to produce at a low weight.

By C. E. BOWDEN

There are many who still do not understand the principle of jet reaction. They think that the eflux or exhaust gases roaring out from the tail push on the air and so propel the craft.

A jet reaction motor operates on the principle of Newton's third Law of Motion, which states that to every force there is an equal and opposite force.

A flow of gas through a nozzle, or jet, requires a force to give its high velocity, and there is thus an equal force on the container, driving it forward in the opposite direction to the jet outlet. In other words, we may say that the force of the expanding gases is actually taken by the engine's body and thence transmitted to the airframe or the boat's hull.

BASIC PRINCIPLE

Fig. 1 shows the general principle by the well-known sphere or balloon idea. In this sketch it will be noticed that if an expansion or "explosion" of gas takes place in a sphere, an equal pressure takes place internally on all sides. If one side is opened suddenly, the gases will rush out from that side, and the pressure will drop, but is momentarily maintained at the opposite side.

Therefore, the sphere gets a kick in the opposite side from the open vent.

Every boy will have noticed that when a child's toy balloon is blown up and the vent suddenly released, the balloon will shoot violently off in the opposite direction to the released vent. This is the principle of jet reaction, for the front of a jet engine is virtually closed in varying ways and the rear is open.

The most usual engine for full-size

work is the gas turbine, because this type can be run up on the ground and throttled back within reasonable limits in the air.

The Athodyd, or the ram jet, is the most simple jet engine and, in fact, the most simple prime mover in the world; it is suitable for supersonic speeds but has the very big limiting factor that in order to start it has to be moved through the air at between 200 to 500 mph. This is generally done by the means of rockets. Naturally, such a jet is not suitable for normal aircraft.

The Athodyd is just a tube with a diffuser at the forward end and a ring of fuel jets behind the diffuser. There is no air compressor and turbine to drive the compressor, as in the gas turbine (see Fig. 3).

A further type of jet motor is on the lines of the German "buzz bomb" in the last war. This is the pulse resonance flap-valve jet engine and is the one which has been developed by the Americans for model work.

A BUZZ-BOMB IN MINIATURE

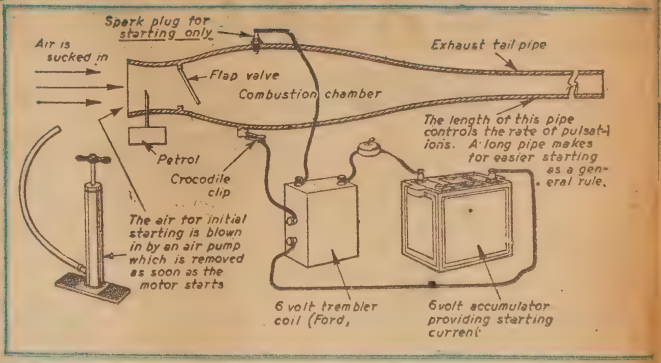


Fig. 2—The basic principle of the model pulse-flap valve jet motor.

BRITISH MOTORS

The British have followed their lead, which has resulted in the very powerful and noisy engine I mentioned at the beginning of this article.

This type of engine is a highly scientific achievement although it is so simple in construction. It is a most efficient power producer, giving over 3½lb static thrust on the ground for an approximate weight of 1lb. As the speed rises through the air there is a considerable rise in thrust.

There are no complications of compressor or turbine as in the turbo-jet, and yet we have this most important thrust from rest which makes it useful for model aircraft. How is it done?

The general principle is shown in Fig. 2. The engine is essentially a tube, the length of which affects ease of starting and power output as well as the exhaust note. Air is sucked into the nose where there is a venturi (ie, a restricted tube) which creates suction over a fuel jet.

The suction created raises fuel from a tank situated just below the jet. The fuel is ordinary car petrol,

Fig. 1—The basic principle of jet forward reaction. (Left). An explosion in a sphere creates an equal force on all sides internally. (Right). If a vent at one point is opened there is a low pressure there, and the force will remain momentarily high at the opposite side, thus giving the sphere a push in the direction of the large arrow. This is the force of reaction employed by jet engines.

valve. There is a sparkplug fitted in the wall of the combustion chamber facing the intake orifice. This is for starting only.

Behind the flutter-valve there is a radiused "button" to limit the movement of the valve's petal-like arms. The combustion chamber is extended into a long exhaust pipe, which is restricted in diameter. This long pipe gives an extractor effect like the long pipe of a racing motor-

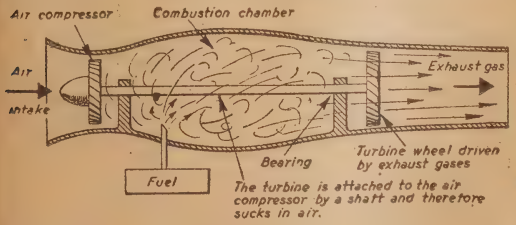


Fig. 3—The principle of the "turbo-jet" or gas turbine engine.

and there is no lubricating oil used, for there are no other moving parts than a springy steel flap-valve. Petrol is easily vaporised and burns sufficiently fast to suit the high pulsation rate. The flap-valve, or flutter-valve as the Americans call it, is located in the nose behind the fuel jet.

The petrol/air mixture, in the form of an explosive gas, is sucked or blown by a pump for starting into the combustion chamber through this cycle's exhaust. The nose of an American Dynajet engine reveals the flutter-valve's ten little petals.

A trembler coil is generally used to create the initial starting spark, after which the engine runs by its own heat. An old T Ford trembler coil, using six volts, makes a useful unit, as there is then no need for a make - and - break and contact breaker, for the Ford coil gives a constant stream of sparks when the current is switched on. A car hand-pump is used to introduce the initial blast of air.

To start, the air pump is connected to the starting tube on the engine nose and air is pumped by hand in steady blasts, which draws up the fuel from the fuel jet and, mixing with the petrol, forms an explosive mixture.

This mixture is forced through the flutter-valve, which is opened by the air blast, where it meets the stream of sparks from the coil.

An "explosion" results which shuts the flutter-valve and gives the forward reaction push to the engine's internal body, at the same time the expanded gases rush out of the open rear tube, thus causing an extractor effect or a partial vacuum in the combustion chamber. This opens the flutter-valve petals and draws in a further charge, which is fired this time by heat created from the first "explosion."

CONTINUES TO RUN

The air pump and the electrical gear are removed and the motor runs until the fuel ends or becomes too weak or too rich through possible maladjustment.

It is hard to think up a more simple engine giving greater efficiency. Certainly there is far less complication than the reciprocating petrol motor with its piston, connecting rod, crankshaft and bearings to be carefully fitted and lubricated.

But, on the other hand, the pulse-jet engine has to be carefully designed to get the right harmonic balance between length and thickness of pipe, flutter-valve thickness, and springiness and limiting stop, &c. Any one of these features, if out of place, may stop the engine working.

The length of the tail-pipe control, the frequency of the pulsations, and, therefore, the time of ignition, is controlled by this resonant frequency, subject to subsidiary factors such as fuel strength and the thickness and springiness of the thin tempered steel flutter-valve.

If the tail-p is shortened, the frequency of the explosions increases.

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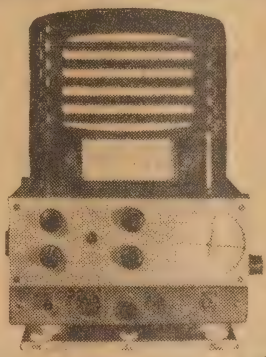

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A long pipe usually means easier starting and a little less power. The American Dynajet has a pulsation frequency of 280-300 per second, which accounts for the noise!

AVAILABLE TYPES

The engines all run very hot and rely upon forward motion to keep reasonably cool. They therefore should not be run up for more than a few seconds on the ground. In the failing light of evening they emit a lurid red glow with licking short flames from the exhaust as they fly around on a control-line model. This glow, added to by the noise, makes the whole performance most intriguing, and adds a spice of excitement to the high speed at which the models fly.

The following dimensions of leading jets may interest readers:

American—Dynajet: Length 21¼in., max. diam., 2¼in.; tail-pipe diam., 1¼in. **Minijet:** Length 28¼in., max. diam. 2in., tail-pipe diam. 1in.

British—Juggernaut: Length 21¼in., max. diam. 2½in., tail-pipe diam., 1¼in. **Decojet:** Length 30¼in., max. diam. 2 5-8in., tail-pipe diam 1 1-8in.

FUEL CONSUMPTION

The fuel consumption is approximately three times as great as the "hot" racing 10 c.c. class petrol motor. The latest Dynajet Red Head produces over 4½lb static thrust.

Ram air as the model's speed rises increases thrust and must be allowed for in the design of the model.

If air bubbles get into the fuel-line the motor will cut dead, whereas a reciprocating engine will generally misfire and keep going through flywheel effect. There is no flywheel on a jet engine of this type. It is therefore vital to ensure a perfect flow, and the fuel pipe must not be smaller than 1-8in bore.

An undercarriage and wheels which do not cause undue bumps on take-off are necessary.

Never look down the business end of the tail-pipe to see if the sparkplug is sparking properly. There may be some petrol in the pipe, which may suddenly give a blast, with very unpleasant results. Never touch the engine when it is working, as it glows red hot. It must be mounted on the model with a good air space for insulation and it should have a shield or asbestos protection on the model immediately below the engine. Steel straps should be used, rather than thin aluminium, which have been known to burn through.

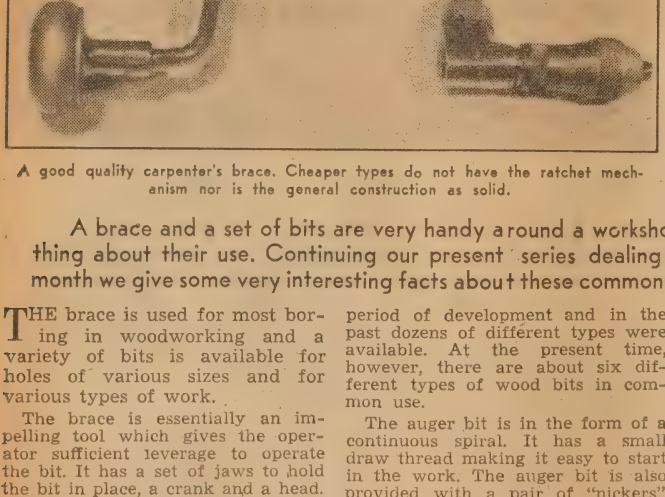
SUCTION-FEED

Petrol feed should always be arranged to suck up and not be gravity fed, as this may cause a fire by allowing fuel to collect in the combustion chamber.

To start, it is usually a good plan to "choke" the nose orifice by the fingers or a rag to enrich the mixture. One soon learns the best amount of choke to give to suit individual engines. Finally, remember that petrol is highly combustible stuff, and an open flaming exhaust can be a source of danger if operated by an irrespon-

(Continued on Page 99)

THE CARPENTER'S BRACE & BIT



A good quality carpenter's brace. Cheaper types do not have the ratchet mechanism nor is the general construction as solid.

A brace and a set of bits are very handy around a workshop, especially if you know something about their use. Continuing our present series dealing with woodworking tools, this month we give some very interesting facts about these commonplace but very important items.

by Maurice Findlay

THE brace is used for most boring in woodworking and a variety of bits is available for holes of various sizes and for various types of work.

The brace is essentially an impelling tool which gives the operator sufficient leverage to operate the bit. It has a set of jaws to hold the bit in place, a crank and a head. Using the brace is a two handed operation and free running grips are provided.

BALL BEARING HANDLES

It was customary in the past to make these handles of wood but nowadays braces with metal handles are frequently to be seen. These are efficient and easy to use and will stand up to continuous hard work.

The better types of braces are provided with a ratchet mechanism which enables the bit to be turned without it being necessary to turn the crank through the full 360 degrees. By the use of the ratchet it is possible to bore holes in cramped spaces. An adjusting sleeve which permits the ratchet to operate in either directioin is provided. By setting the adjusting sleeve in the intermediate position, the jaws can be firmly locked to the crank.

Bits designed for use in a brace have a tapered, square section shank and the jaws of the brace are designed to hold the shank firmly. To tighten the bits in position the socket is turned in a clockwise direction. The tapered ends of the jaws are pressed together by the tapered inside surface of the socket. A small steel wire spring keeps the jaws pressed against the socket to allow easy insertion of the bits. The jaws are held in a slot so that pressure on the bit in either direction does not have any tendency to loosen the socket.

Wood bits have undergone a period of development and in the past dozens of different types were available. At the present time, however, there are about six different types of wood bits in common use.

The auger bit is in the form of a continuous spiral. It has a small draw thread making it easy to start in the work. The auger bit is also provided with a pair of "nickers" and a pair of "routers." The thread screws into the wood first and the sharp nickers cleanly scribe the diameter of the hole on the surface of the wood. The routers follow by scraping the wood away from the centre of the hole. As the bit enters the hole the spirals perform the valuable function of keeping the bit in a straight line and resisting any tendency to follow the direction of the grain.

LARGER SIZES

About 1" in diameter is the largest auger bit which can be accommodated by an ordinary brace. With sizes very much larger than this the torque required is too great. Bits of from 1" to 2" in diameter are made with a large eye. A piece of stout wood or piping can be passed through the eye to give the required leverage. These tools are, of course, used quite independently.

It is possible to resharpen auger bits and the operation is carried out with a file. Rest the bit on a board with the screw down and file the upper side of the cutting edges only. Take care to file both cutters the same amount so that they will both be on the same level and will cut chips of equal thickness. It is also important that the "nicker" be sharp.

Actually, some auger bits which are designed for work in very hard wood do not have the nickers. However, the hole they cut is not as clean as with the type we have been discussing.

Centre bits are capable of cutting a particularly clean hole and are frequently used, especially in thin timber. They have a tendency to drift with the grain and therefore should not be used to bore holes of any great depth. Where a clean edge is required on each side of the hole, the bit should be reversed to the opposite side of the job when about half way through. The same technique can be employed in using the auger bit.

The cobra or nail bit is used mainly for boring holes for screws or nails. It has no draw thread or any actual cutters. Its disadvantages are that it is easily broken and it tends to split the wood.

The cobra bit has been largely superseded by the wood drill. It is similar to the metal twist drill. However, for a given size, the twist is not so great nor has the wood drill the lands for relieving friction, which are found on the metal drill.

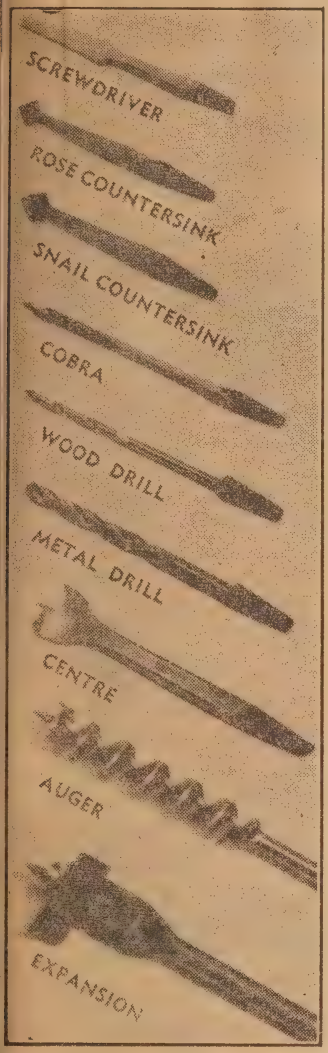
SHARPENING

The wood drill is sharpened at a much steeper angle than the metal drill. It bores a very much cleaner hole than the cobra bit and requires less effort on the part of the operator. The wood drill is suitable for the smaller sizes while the auger bit is most efficient for large holes.

Countersink bits are used to taper the hole to take the head of a screw and there are at least two types in common use. The snail type has a single cutting edge and is especially useful in soft timbers as it takes a clean shaving. The rose type has a large number of cutters and can better cope with hard timber although the finish left by it is not normally as good as the snail type. The rose type countersink can also be used for soft metals.

Screwdriver bits are also available to fit a standard brace. They make the operation of inserting wood screws very much easier than with an ordinary hand screwdriver especially if the job is a big one. In the larger sizes, very much more

TYPICAL BITS



Types of bits available for use in a hand brace. All have a tapered square section shank.

torque can be exerted with a brace than is possible with a conventional screwdriver.

The expansion bit is about the most interesting of the wood bits. It is very similar in principle to the auger bit and consists of a draw thread, a fixed nicker and router of small diameter and a larger adjustable nicker and router. The usual range of adjustment is from 5/8" to about 3¼" which makes it a very handy tool to have around a woodworking bench. Like the centre bit, it has a tendency to wander with the grain.

There is no universal numbering system for wood bits. Auger bits, which are generally used for the larger sizes, have a number stamped on the shaft which indicates the diameter is 16ths of an inch. Thus a number 6 auger bits would be 3/8" in diameter.

NUMBERING SYSTEM

Wood drills are made in graduations of 1/32" and when a numbering system is used the number generally indicated the size in 32nds of an inch. For example, a number 6 wood drill would be 3/16" in diameter. In many cases, however, the diameter in inches is stamped on the stock of the drill to avoid any confusion.

Cobra bits, also, are available in 1/32" graduations and are frequently numbered similarly to the wood bits.

A woodworker is frequently called upon to bore holes fairly deep and accurately into wood and the knowledge of a few of the tricks of the trade is invaluable. One simple method is to cramp a straight piece of wood as close to the hole as possible and use it as a guide. This makes it fairly easy to see if the bit is out of line. Where a number of holes must be bored accurately the same distance from an edge the idea can be extended by making a jig to fit around the shank of the bit.

It is very difficult to bore a hole obliquely to a surface but the job can be made much easier by constructing a jig which will allow the bit to start at the required angle. This can be done by boring a hole straight through a piece of scrap wood first, and then cutting the wood at the appropriate angle. Use a G cramp or other similar fixing device to hold it in place temporarily.

Maxwell's OUTSTANDING VALUE

Huge Purchase

MARMAC MOTORS

Adjustable Stop and Start. This mechanism is adjustable for all types of pickups. Brand New. Boxed and guaranteed.
Induction Motor—Variable speed 12" Turntable.
Special Quote for lots of Six or more.

79/6

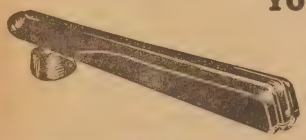
GOLDRING LIGHTWEIGHT PICKUPS

121 with Sapphire, **£3/13/10**
125 for Standard Needles
£2/17/-

GOLDRING BANTAM PICKUP

(Almost Lightweight)
130 .. .. **£2/1/2**

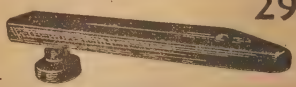
YOUNG ATOM



Magnetic Pickups **27/6**
Needle Pressure 1¼ ozs.
Output at 1,000 C.P.S. of .5 Volts R.M.S.

ENGLISH COSMOCORD CRYSTAL PICKUPS

Medium weight. Well-known ENGLISH make



29/11

AMPLIFIER KIT SETS

To build Yourself

* 3 Valve. 6SJ7, 6V6GT, 6X5GT.
* 3½ Watt
* Ideal for Pickups

Complete Kit, **£9/19/6.**
Cabinet if required £2 extra.
Size 12" high x 12½" long x 5" wide.

MAXWELL'S RADIO

48 ELIZABETH ST., MELBOURNE. CENT. 4913

Same Day Despatch — Add Postage to All Amounts

"SPOT WOBBLE" CUTS OUT TELEVISION LINES

(Continued from Page 21)

from wondering why it was not thought of and applied at the very inception of c.r.t. television. But it is the way of important inventions to be completely simple—and of people to kick themselves for not having thought of them.

What will happen if a small, rapid up-and-down movement is superimposed on the lateral travel of the spot? Make the movements in the vertical sense sufficiently rapid and the amplitude of those movements so small as not to overlap seriously the boundaries of one scanning line, then the wobbling spot will activate virtually the whole rectangular area of the screen corresponding to the line.

To put it in another way, there will be what amounts to vertical elongation of the spot, and this, if correctly regulated, will annul the failure of the sharply focused spot to cover the full width of the scanned strips which, in the ordinary way, provides each line with dark borders and gives rise to lininess.

GAPS FILLED

The scanning element becomes a short, vertical line instead of a spot and the gaps are filled without losing horizontal definition.

That, precisely, is what is done in spot-wobble. The effects are illustrated diagrammatically in Fig. 2. By using spot-wobble we scan, in effect, not with a roughly circular spot, but with an elongated spot.

The essence of the spot-wobble system is to give the spot a vertical movement at a frequency approaching 1000 ups and downs—let us call them cycles—per line. For our British 405-line, 25-image-per-second system this means a frequency of the order of 10 Mc/s.

It would clearly not be feasible to apply this at the transmitter, the total modulation band width of which is some 2.8 Mc/s. But there is no need for this. Spot-wobble is, in fact, essentially concerned with the receiver; and it is so simply produced that the additional cost need hardly exceed £1.

It might be done electronically by the use of two small deflector plates; but I was given to understand that magnetic methods are used in the instrument which we saw.

The necessary additional circuits are shown in Fig. 3. The on-off switch is required because the receiver should be focused as sharply as possible with the wobbler out of circuit. That having been done, the switch is closed. To start with the control knob should be at the position giving minimum amplitude. Then the amplitude is gradually increased until the best balance is reached between welcome loss of lines and unwelcome loss of definition.

TWO COMMON COMPLAINTS

Could you please tell me why my receiver always starts up with a sudden burst of volume? Most sets come on gradually.

Technically the answer to this question is very simple but we quite agree that the effect is disturbing, particularly if one has impatiently turned up the volume and is waiting for something to happen.

When you switch on a mains-operated receiver, it does not commence to play immediately, because it takes some time for the cathodes of the valves to reach their normal operating temperature.

In most cases, the heating time is only about 10 seconds, although it does seem longer than this if you are waiting on a serial that you almost forgot. However, some of the earlier continental valves take much longer than this, apparently because of their more massive cathode structure. Ac-dc receivers are also slow off the mark, but for a different reason.

A superhet. receiver cannot operate until the local oscillator begins to function, and this happens gradually in most receivers. The valve goes smoothly into operation as the others warm up and the signal gradually comes up to normal level.

But the oscillator may be slow in starting, due to the valve having a slower heater, or to other circumstances in the oscillator circuit. Meanwhile all other valves have reached their normal temperature and, due to the lack of AVC voltage, the gain of the receiver is momentarily very high. Then on comes the oscillator and in comes the signal in a very abrupt fashion.

Apart from the fact that it is nicer to have the signal fade in slowly, there is no harm done by the abrupt start and therefore no real need to worry about the matter. However, if you want to check up on things, have the converter valve tested and make sure that it is a good one. If the emission or transconductance is low, the commencement of oscillation may be delayed just long enough to give the abrupt start.

A poorly-designed oscillator coil could also give the same effect, or the use of restricted oscillator anode voltage. Check on the operation of the converter to see that the operating voltages are somewhere near the maximum for the particular type. Substitution of a smaller dropping resistor or a readjustment of the clip on the voltage divider may be necessary.

Why does my receiver always give out a piercing squeal before it commences to play?

We can sympathise with readers who address this complaint to us, because it is certainly a most distressing effect. It is fortunately not very common nowadays but was frequently encountered in receivers using some of the older continental valve types.

It is clearly traceable to the converter valve but we have never heard an authoritative explanation of just why certain valves should behave in this way. In bad cases, the offending valve has simply been replaced, but, like as not, it may be quite normal in another receiver.

The squeal is apparently due to a combination of random effects producing some form of squegging in the oscillator section before the oscillator proper commences.

If your set gives this trouble, we can only suggest that you experiment with the operating conditions of the converter valve to see whether the squeal can be eliminated. Try a smaller oscillator grid condenser, and vary the value of the grid resistor. Also try reducing the oscillator anode or screen voltage and note the effect of an extra bypass on the AVC line.

If that fails, you had better try a new converter valve—unless some reader has a sure-fire cure that we don't know about.

WE HAVE NOTICED:—

● While some constructors take great pains to make a good job of a receiver, they are apt to forget to allow for the thickness at the front of a wooden cabinet when cutting the control spindles to length. Such omissions necessitate the extra effort of adding to spindle length. In some cases, it is possible to overcome the difficulty by cutting the spindles very short and using standard extension shafts. Alternatively, the necessary extra length can be soldered on, or each spindle drilled and tapped to take another short piece similarly treated.

● Where grub-screws are threaded into the bakelite material of knobs, the thread is hopelessly stripped by the exertion of too much force. File a flat on the shaft and excessive pressure is not necessary.

★ ★ ★

● That in this column some months ago a figure of 22,000 ohms was quoted as the feedback resistor in the Williamson amplifier when the output transformer matches 500 ohms. This was a typographical error. The correct value is 27,000 ohms.

NEW ADDITIONS TO THE 'GOLDRING' RANGE—1950

SAPPHIRE S/5. This newly-developed **Sapphire Jewel Point Needle,** is the latest addition to the range of "Goldring" Sapphire Needles which enjoy a high reputation for uniformity. It is the result of many experiments conducted with the main object of finding the ideal needle of a resillient and shock absorbing type for use with **modern record changers.**

The Sapphire S/5 is robust and accurate in its dimensions and by abolishing the main worry of users of record changers, how to avoid needle changing and at the same time preserving their records by the use of a permanent needle, this Sapphire will definitely provide the answer.

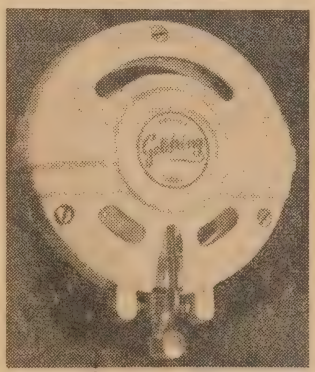
A milled flat for exact location is provided.

Like all other "Goldring" Sapphire Needles, the Sapphire S/5 is guaranteed against faulty workmanship and material.

DIMENSIONS: Shank 1/16"
Material—Aluminium.
Point Radius—.00325"
Angle—50 deg.
Made to highest precision limits. **Retail Price, 13/6.**

LONG PLAYING SHADOWGRAPH NEEDLES. A steel needle of highest quality and which has undergone the strictest possible tests to assure uniformity and quality. Highly polished and made of best quality Sheffield steel. Will play 10 standard size records and therefore, the full load of a record changer. Suitable for acetate records. Available in attractive blue plastic boxes containing 100 needles, **5/3.**

To introduce this needle, which is, in our opinion, and according to experts, the best steel needle ever made. **an introduction pack** of 12 needles for 1/- is also available.



LIGHTWEIGHT SOUND BOX NO. 50. Having manufactured sound boxes for accoustic gramophones for over 40 years, "Goldring" have considered it advisable to give the large number of users of accoustic gramophones the benefit of their recent experience and the general progress in the use of plastics for musical instruments.

This is the main reason for the development of a "lighter than before" sound box with its "sound" reproduction and eye appeal.

It is reasonably priced and will be an improvement as regards record wear. Weight approximately 3oz. **Retail price, 13/6.**

CLEANING PAD. An essential requisite for every record collector is the new "Goldring" record cleaning pad. Keeping dust out of the grooves of your records is much more than just being tidy; it saves you listening to unpleasant noises caused by such dust, especially when using VINYLITE records with their low surface noises and their tendency to attract dust.

Therefore a record cleaning pad becomes almost as important as a record itself.

This inexpensive, very well finished and attractive article has been designed and manufactured in our St. Mary's factory. **Retail price, 3/9.**

For Technical Information please write to Service Dept.

GOLDRING ENGINEERING (A/SIA) PTY. LTD.,
57 H.E. AREA, ST. MARY'S, N.S.W.

Phone: St. Mary's 447 **After Business hours, UW6907**

AN "OUTBOARD" I.F. CHANNEL

(Continued from Page 67)

ible to feed a signal through the nit from the I.F. channel of the re-eiver.

Connect the RF input, the AVC nd the audio terminals to the re-eiver proper. Satisfactory coupling an usually be achieved by taking a ead from the input terminal to the liode detector and twisting it around he lead from the last 455 kc trans-ormer to the diode. If the capacity f the coupling condenser so formed s insufficient a 10 or 25 pf condenser nay be installed.

Since we have included an isolat-ng condenser in the outboard unit, lirect coupling is permissible, pro-ided it does not result in instability. n any case, a length of low capacity o-axial cable may be used to pro-ide a shielded connection.

INAL ADJUSTMENT

The AVC line in the receiver is lisconnected from its normal supply nd returned to the AVC terminal on he outboard unit. The audio is aken, via a length of shielded wire, o the audio input stage of the com-nunications receiver. It will usually e possible to make connection with he hot side of the volume control nd arrange the circuit so that it will unction normally.

The I.F. transformers in the out-oard unit will come from the fac-ory set fairly close to the correct requency and it will normally be ossible to pass a signal through the nit after the oscillator has been et up on frequency as previously lescribed. Either or both channels nay be slightly off frequency. To ompensate for this the local oscilla-or in the outboard unit can then be aried slightly to obtain the maxi-num signal. Make the latter adjust-nent on noise alone, as any signals present are only likely to be confus-ng.

If no signal generator is available o set the local oscillator it is simply matter of tuning around until the orrect setting is found. This should ot be too difficult, with the infor-nation previously given.

The BFO for the 50 kc unit war-ants special mention. We believe hat the manufacturers intend at ome future date to make special 50 kc BFO coils available. However, it the moment only the transformers re on the market. We therefore onducted some experiments to scertain if the transformers could e adapted for use as BFO coils.

50KC B.F.O.

Following previous practice, we emoved the condenser from one winding and connected it as a feed-back winding in the usual grid tuned oscillator circuit. The circuit showed no signs of oscillating, so we restored the tuning condenser hoping to make it operate as a tuned plate/tuned grid oscillator. The BFO did actually work with this connection, but oscil-ation was rather uncertain due to he low coupling between the two windings. Our final circuit, there-fore, includes a condenser to increase the feedback.

Although the circuit must be con-sidered as something of a freak we do not apologise for it, as it enables a 50 kc BFO to be constructed when a special coil is unavailable.

Some readers may have 175 kc transformers available and wish to construct an outboard I.F. unit having more selectivity than is available from a single stage. It is possible to achieve this result with three trans-formers, the second two of which are coupled back-to-back.

The extra transformer will necessi-tate a modification to the layout, but this should not cause any difficulties as it is not particularly critical. Actually, the layout we have sug-gested is only one of the many pos-sible, and we recommend that it be varied to suit individual require-ments.

The construction of the unit, wiring, &c., are not particularly difficult, and it can be successfully completed by anyone who has pre-viously had the experience of con-structing one or two receivers. Its use will multiply by many times the number of signals which can read through interference and generously reward the constructor for his effort.

MAINTENANCE FOR FAN MOTORS

FAILURE of small electric-fan motors usually is due to four common causes—lubricant hardened or dried, bearings clogged with dust, brushes worn short and a loose con-nection.

Removing the end shield generally exposes the brush-holder plate, the brush holders, and the resistance unit. Excessive wear of the brushes frequently causes the brush pig-tails to jam in the holders, thus in terfering with proper brush contact on the commutator. If the brushes are so badly worn that the pigtails jam or the follower springs no longer bear on the top ends, then they should be replaced. If new brushes are not readily available, replacements can be made from com-mon generator brushes. Measure the old brush to get the exact size. Then cut the generator brush to these dimensions and drill for the pigtail. Drill another hole at right angles through the first one and ancho the pigtail with solder. If the com-mutor brush track is badly carboned, it must be cleaned.

Mount the armature in a drill chuck, and clean and true the com-mutator with a piece of fine sand-paper. Clean the armature bear-ings with a solvent, such as kero-sene, and apply new lubricant before reassembling the motor.

AMATEURS — DISPOSALS — EXPERIMENTERS

Midget Genemotors

INPUT: 28 Volts at 1.1 Amps.
OUTPUT: 250 Volts at .06 Amps.
SIZE: 4½ x 2¾. Weighs only 3⅞ lbs. Perfect for use with 32 Volt Domestic Receivers.
32/6, Postage 3/6 extra.

Portable Masts

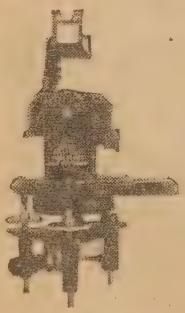
Portable Dural Masts in 3ft. screw - together sections, diameter ¾ inch. Minimum. quantity for mail order, 6.

3/- per section F.O.R.

Tripods

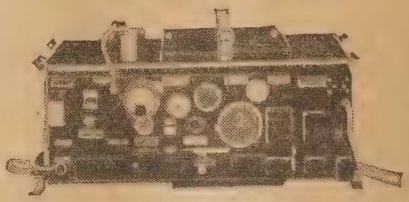
Army type folding Tripods used with Lucas Signalling Lamps, etc. Excellent as a Camera stand.

12/6 F.O.R.



Astro Compass

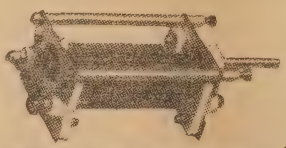
An ideal instrument for the Amateur Astronomer.
40/-, Postage 2/6



No. 11 TRANSCEIVERS

Complete with carrying Rack and all leads, meter, Genemotors, Headphones, microphones, etc.
A complete amateur Portable Station, fully tested and ready for use. Shock mounted, these transceivers are ideal for installation in vehicles. Frequency range 4.2 to 7.5mcs. Standard valves throughout.
Weight packed in a solid wooden case for safe transit—130lbs.

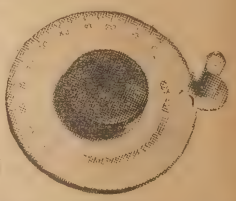
£12/10/- F.O.R.



TRANSMITTING CONDENSERS

30 Plate, high grade insulation ball bearing shaft support.
Shaft diamenter 1 inch.
Length excluding shaft 3½ inches.

10/-
Postage 1/- extra.



VERNIER DIALS

Transmitting type, 2½ inches in diameter.
0-100 etched scale.
Positive action friction drive.

7/6
Post free.

MN26C RECEIVERS

New in cartons complete with Bandswitching Motor, Genemotor and all tubes as follows:—5-6K7, 2-6J5, 2-6N7, 1-6L7, 1-6B8 and 1-6F6. This Receiver has 2-R.F. Stages and B.F.O. Hairline selectivity is obtained with the use of 112 m/c. in the I.F. channel. Frequency coverage 150 to 1500 kc. Ideal for use with Converters.

£12/17/6 F.O.R.

GENEMOTORS

If you have a Car Radio wanting a Power Unit, here it is. A Genemotor that will operate efficiently on 6 volts. Made for operation on 9 Volts, these Genemotors have an output of 230 Volts at 69 ma. Complete that Mobile Rig now.

50/- Postage & Packing 3/- extra.

Available also at—
No. 5 Royal Arcade, Sydney.

PARAGON RADIO

Address all mail to—
Box 14, P.O. Haberfield, N.S.W.

THE HISTORY OF ELECTRICITY

(Continued from Page 11)

It was during these years that Ohm slowly climbed his way into recognition in the scientific world. The Royal Society of London, as we have seen, took the first step in paying tribute to his investigations. This accomplished, other learned bodies and schools followed suit. After a lapse of more than ten whole years, Ohm's Law" at last come into general recognition as an electrical generalisation having the most extended theoretical and practical possibilities.

By a sort of general consensus of opinion technical people gradually began to refer to the electrical unit of resistance by the title of "Ohm," so that when this term was officially adopted internationally by a congress of electricians, which met in Paris in 1884, the "Ohm," as an electrical unit, needed little introduction.

The tragic circumstances of Ohm's earlier creative life seem, in a way, to have sapped his originality, so far as electrical researches were concerned. He never again repeated his earlier electrical triumph. Rather, he seems to have gone in more for literary work, as, for example, the writing of a great treatise on molecular physics, a work, however, which was never finished.

He wrote a textbook of physics and various other papers dealing with the theory of sirens, musical sounds, interference of light by crystals, various optical matters and other subjects. But never again did original electrical work seem to be uppermost in his mind. The tremendous disappointment and the cruel injustice which he had suffered in connection with his earlier investigations never seemed to forsake him.

Yet Ohm was now able to improve his life's circumstances. After a successful spell at Nuremberg he was, in 1849, called to Munich as curator of the great Physical Museum in that city. He became a "Councillor" of the German telegraphic administration, and in 1852 he was made professor of experimental physics in the University of Munich.

This was the fulfilment of a long-cherished ambition, for a professorship at Munich carried with it European recognition of ability, achievement and status.

At Munich, official duties piled themselves rapidly on Ohm's shoulders. They appear to have depressed him greatly. His health failed, and early in 1854, he suffered an apoplectic stroke from which he recovered with sufficient strength of mind and body to continue his lecture work.

But on July 6th in the same year, late in the evening, just before he was due to retire to bed, another stroke came on. This time he failed to recover, dying shortly after the attack.

So ended Ohm, apostle of electrical resistance.

Georg Simon Ohm was a curious man, and even in the scientific world he was something of a recluse. He was known personally only to a few friends and to a select inner circle of students.

Ohm's career is now almost forgotten. The memory of the man has long faded. Only the international unit of electrical resistance, the "Ohm," nowadays serves to remind us that he once lived.

A COMPLETE PORTABLE RECORDER

(Continued from Page 43)

fitted with a 5 mA instrument rectifier and a suitable multiplier.

The multiplier is adjusted to give a suitable deflection when 70 volts can be measured across the coil of the cutter at 1000 cycles. Do not use a disposals rectifier if accurate indications are to be obtained. The frequency response of the disposals rectifiers, which were not originally intended for use with meters, is poor, dropping away quickly above 1000 cycles. If you do not wish to use the indicator during "playback," then it can be connected in parallel with the cutter and simultaneously switched out of circuit.

The speaker, which is used for playback purposes, is a lightweight 3in permanent magnet type and is mounted in the removable lid. It is not intended to give high-fidelity reproduction, but only as a means of immediately playing back a record. The lid also contains cleats around which the various cords are wound.

My experience when cutting lacquer discs has proved beyond all doubt that, even for home recording, a sapphire cutting stylus is to be preferred to the more common steel variety. I know that they are much more expensive and also much easier to damage than the steel types, but, if you are careful with them, they will last twenty to thirty times as long as the steel stylii and will give really quiet grooves. In fact, with a good quality disc and sapphire stylus it is almost impossible to hear any surface noise, even on the best wide-range equipment.

The tuner used for "capturing" radio programmes is a rather elaborate affair. It is a superhet and, as it is used for local reception only, it uses no RF stage. The IF channel, however, operates at 2 Mc, is overcoupled to give a flat-topped response curve, and of the two stage type to give good rejection of adjacent signals. The detector is a diode, which operates directly into a cathode follower output valve. This reduces the shunting on the diode load to a minimum and allows a low impedance line to be used between the amplifier and the tuner.

The tuner has a tuning indicator connected to the AVC system, and also a filter which tunes out the 10,000 cycle heterodyne whistle.

A tuner of this type is capable of excellent results, but is not an ideal proposition for the average home constructor. The alignment procedure is difficult and has to be done accurately. Also, the over-coupled IF transformers have to be handmade, as was the oscillator coil. The final adjustments to these coils were checked with a high-grade commercial "Q" meter, an instrument which is not generally available to the home constructor.

Well, that just about completes the story of my own portable recording unit. It now makes very good recordings with a minimum of trouble. However, don't think that making a good record is easy, even with good equipment. It calls for experience, involving a lot of blanks, a broken sapphire or two, and a lot of patience.

THE SUPERFORT, GETS TOUGHER

(Continued from Page 77)

partment which contains three gun-sighting stations in transparent blisters, one on the top and one on each side of the fuselage. In the extreme end of the fuselage is the tail-gunner's pressurised compartment.

The three pressurised sections are served by two superchargers driven from the two inboard engines.

All crew positions are armored or protected with armored anti-flak curtains.

Span is 141ft 3in, and length is 99ft.

Maximum speed of the B-29 has been revealed as 351 miles an hour and range 2850 miles, but details of the performance of the B-50 have not been made public.

SHORT WAVE NOTES BY RAY SIMPSON

POLICE RADIO NETWORK IN FLOOD AREAS

During the past few weeks many areas of NSW have been subjected to extensive flooding and in some cases unfortunately with a tragic loss of life. Communication between the various townships has been carried on by whatever methods were available and naturally radio has been to the fore in this regard.

WHILE we do not have details of all various radio facilities which were made available, we did hear the Police Department at Wagga and Narrandera exchanging messages regarding danger areas, &c. These transmissions were being broadcast on a frequency of approximately 5.05 mc.

The Army have also been doing some great work by means of their amphibious "ducks" and they, too, have been heard communicating by radio, though we are not quite sure whether these were actually from the "ducks" or from control stations on higher ground.

As we write these notes we see by the Press that the police are arranging a hookup with an amateur station in Warren, as this town was practically isolated. In the past, the amateurs have been of great assistance to the various authorities in maintaining contact with the stricken areas, and we feel sure that in the present crisis they will once again prove of great assistance when other means of communication are not available.

AMBULANCE RADIO

For some time now the Central District Ambulances in Sydney have been equipped with two-way radio and this has proved to be a very valuable aid in contacting them while they are away from their depots. It has just been announced that all other ambulance services in Sydney are also to be fitted with radio and thus bring them into line with the Central District organisation.

Practically all public utilities are now equipped with radio, such as the Fire Brigades, Water & Sewerage Board, Electricity Supply, NRMA, and very soon we will have radio telephones in taxis to add to the number.

Some of these services are using FM, while others are still making good use of the older AM.

FLASHES FROM EVERYWHERE

SWEDEN.—The Swedish stations have never been heard in this country at such good strength as the other Scandinavian stations such as Radio Norway and Radio Denmark, but, nevertheless, by careful listening one can hear them on 6.065 mc and at much better strength on 10.78 mc. On Saturday afternoons on this latter frequency you can hear the very interesting DX programme edited by Arne Skoog, and some very interesting tips are often given. This programme comes on the air at 5.15 pm and lasts for 15 minutes, and, of course, is all in English. By listening on 6.065 mc you can compare the programme with 10.78 mc and thus be sure that you are really tuned to Sweden. Call-letters are SBO for 6.065 mc and SDB2 for 10.78 mc.

FORCES STATIONS.—Many Forces stations are still on the air such as those in Malta, but up to the present we have seen no reference to the two United States Forces stations located in Trieste Zone. The first of these operates on 7.582 mc and the other on 10.695 mc, though we have had no reports of their reception either in Australia or the USA. The British Forces also operate a station in Trieste, but this one is only on the broadcast band, operating on 1418 kc. The United States Forces in Japan now operate three stations for the entertainment of their personnel in that country, all of these taking relays from the AFRC, &c. The particular stations are JKL on 4.86 mc, JKK on 6.015 mc and JZL2 on 9.605 mc.

GREECE.—Radio Athens, which is operated by the National Broadcasting Institute, have sent us their present schedule, which shows that they are operating on 7.3 mc, 9.607 mc, and 15.345 mc. Times on the air are as follows:—7.3 mc, power 7.5 kw, 3.0 am to 4.35 am, with news in Turkish, Russian, Rumanian, Serbian, Albanian and Bulgarian; 9.607 mc, 7.5 kw, 3.30 pm to 5.35 pm and 8.0 pm to 11.0 pm, being a relay of medium wave programmes; 15.345 mc, beamed to NW Europe and the USA, with power of 7.5 kw, 1.15 pm to 2.15 am, with news in English, [illegible] and from 8.30 am to 9.30 am, this being a special programme for the [illegible] news in English, a half-[illegible] session and news in Greek.

[illegible] COUNTRIES.—Despite the fact that many Australian and New Zealand listeners log the vast majority of the stations heard in other countries, there are still a few which seem to defy reception. In this regard we mention OXI in Godthaab, Greenland, which operates on 5.942 mc and is on the air daily from 7.30 am to 8.45 am. Then there is ZIK2 in Belize, British Honduras, which never appears to be heard out here when it transmits between 4.15 am and 4.45 am. Still another elusive station is PJC1, on 2.313 mc, and PJC2, on 7.25 mc, both these stations being in Willemstad, Curacao. Finally, there is CR4AA, in the Cape Verde Islands, which uses 5.95 mc, and is reported to be on the air from 7.0 am to 8.0 am. Who will be the first to report any of the above?

FRANCE.—We learn from Sweden Calling DX ers that in connection with the many changes in both medium and long wave stations as a result of the Copenhagen Plan, which came into effect on 15th March, 1950, the French Radiodiffusion Francais, Paris, have transferred their general programmes in English from medium to short waves. These programmes are being given on 6.2 mc and are supposed to be on the air from 5.0 am till 8.15 am. As a matter of interest, however, we noticed this morning that this English session was only on the air from 5.0 am until 5.45 am, but of course may have been on again after an interlude of French. The programmes are of real entertainment value and consist of serial stories, French lessons, weekly quiz, &c.

HMA WARSHIPS — As readers are aware, a number of units of the Australian fleet has recently been in New Zealand waters carrying out exercises with the New Zealand fleet. While these ships were on their way back to Australia they had nightly radio contact with VIS Sydney. Both HMAS Sydney and HMAS Australia were heard at good strength, the former using its call letters VJLR and the latter VJLS. Frequencies in use were either 4.42 mc or 8.84 mc, depending on the conditions, while VIS Sydney was operating on 6.505 mc each time we heard it. These broadcasts were of course point to point transmissions and subject to all the regulations regarding secrecy, that is to say, anything heard must not be divulged.

RADIO NORWAY

THANKS to Graham Hutchins, of Radi Australia, we are able to publish th new schedule of Radio Norway, whic came into effect as from April 1st. Thi schedule was received direct from th station, so should be quite correct.

To North American Waters—

LKV, 15.17 mc, 11.00 am, to noon, week days; 11.00 am to 12.15 pm, Sundays.

LKQ, 11.735 mc, 11.00 am to noon, week days; 11.00 am to 12.15 pm, Sundays.

LLH, 9.645 mc, 11.00 am, to noon, week days; 11.00 am to 12.15 pm, Sundays.

To the Far East—

LLP, 21.67 mc, 9.00 pm to 10.00 pm, week days; 9.0 pm to 10.15 pm, Sundays.

LLN, 17.825 mc, 9.0 pm to 10.0 pm, week days; 9.0 pm to 10.15 pm, Sundays.

LKV, 15.17 mc, 9.0 pm to 10.0 pm, week days; 9.0 pm to 10.15 pm, Sundays.

LKQ, 11.735 mc, 9.0 pm to 10.0 pm, week days; 9.0 pm to 10.15 pm, Sundays.

To Indian Ocean—

11.0 pm to midnight weekdays, 11.0 pm to 12.15 am Sundays, same stations a above.

To African Waters—

LLP, 21.67 mc, 5.0 am to 6.0 am, week days; to 6.15 am, Monday.

LKQ, 11.735 mc, 5.0 am to 6.0 am, week days; to 6.15 am, Monday.

LKV, 15.17 mc, 5.0 am to 6.0 am, week days; to 6.15 am, Monday.

To South America—

LKV, 15.17 mc, 9.0 am to 10.0 am, week days; to 10.15 am, Monday.

LKQ, 11.735 mc, 9.0 am to 10.0 am week-days; to 10.15 am, Monday.

LLH, 9.645 mc, 9.0 am to 10.0 am, week days; to 10.15 am, Monday.

Home Service From Oslo and Fredriksta

SHORT Wave Notes for the June issue are due on May 6. For the July issue they are due on June 10. Please send them direct to Mr. Ray Simpson, 80 Wilga Street, Concord West, N.S.W.

To African Waters—

LLP, 21.67 mc, 4.15 pm to 5.30 pm, week days; 5.55 pm to 8.50 pm, Sunday.

LLN, 17.825 mc, 4.15 pm to 5.30 pm, week days; 5.55 pm to 8.50 pm, Sunday.

LKV, 15.17 mc, 4.15 pm to 5.30 pm, week days; 5.55 pm to 8.50 pm, Sunday.

LKQ, 11.735 mc, 4.15 pm to 5.30 pm, week days; 5.55 pm to 8.50 pm, Sunday.

LLP, 21.67 mc, 6.0 am to 8.0 am, week days; from 6.15 am, Monday.

LLN, 17.825 mc, 6.0 am to 8.0 am, week days; from 6.15 am, Monday.

Home Service From Tromso

To North Atlantic and North Sea—

LKJ, 9.54 mc, 4.15 pm to 5.30 pm, 8 pm to 10.40 pm, week-days; 5.55 pm 12.45 am, Sunday; 4.15 pm, Sat., to 4 am, Sunday; 8.20 pm to 10.35 pm, Satu day.

LLS, 7.21 mc, 1.45 am to 8.0 am, week days; 1.15 am to 3.0 am, Monday; 12. am to 8.0 am, Sunday.

A special 15-minute English programm "Norway This Week," is presented on Sun days at 10.00 pm and midnight, and Mondays at 6.00 am, 10.00 am and noo

At our location, the best of the abo transmitters is LKV, which is excelle between 9.0 pm and 10.0 pm.

SOME RECENT VERIFICATIONS

LRT ARGENTINA.—Latin American verifications have been rather scarce of late, and it was, therefore, very pleasing to receive quite an attractive card from LRT Radio Independencia" in Tucuman, Argentina, confirming reception of their station on 11.84 mc.

Their card gave verification details on the one side and on the reverse was a colored scene, which was evidently a view of some native type carvings. Incidentally, this station is now being heard at excellent strength in Sydney from opening at 9 pm.

FORCES STATION, GREECE.—Art Fishen has recently received a very fine verification from the Athens Forces Station No. 2, confirming his reception on 7.05 mc. In their letter they stated they were so pleased to receive his report they had decided to extend their transmission on April 2 till after 6.0 pm "in order to broadcast an extra transmission dedicated to you."

We tried very hard to hear this station on the day in question, but local amateurs made reception impossible. The address of this station is Lt.-Col. Avgeris Giannis, Commanding Officer, Radio Athens 11, Athens T6, Greece. Incidentally, Art tells us that this station carries a church relay from 4.30 pm on Sundays.

RADIO AUSTRIA.—Readers will remember that some time ago we reported reception of the US Army Forces station in Salzburg as being heard on 9.48 mc instead of their assigned channel of 9.533 mc. A very nice letter of verification has just been received from the station confirming reception on 9.48 mc (actually 9.485 mc), and they state that the station is now known as RDN, or, in other words, "Blue Danube Network." The call-letters of this station when it was using 7.22 mc was KZCA, but more recently has been using KZBN until this was again replaced with BDN.

SIAM.—Some few months ago we made mention of a new Siamese station, which was heard on 15.91 mc, and which, according to the call-book, had the call-letters HSJ4. The Publicity Department of the Overseas Broadcasting Station in Bangkok has now sent along their very attractive verification card confirming reception of this station, but we note that they give the call-letters as HSPD rather than HSJ4. They refer to most of their other stations as HS8PD, but in this case there is no mention of the numeral. Incidentally, this station is still being heard on most nights in parallel with their other outlet on 6.235 mc, but never at such good strength.

RADIO CANADA

WE are indebted to Radio Australia's DX session for the latest schedule of Radio Canada, which came into force as from April 2.

TO EUROPE—

CKNC 17.82 mc, 12.15 am to 9.15 pm (from 1.35 am, Mon.).
CKCX 15.19 mc, 12.15 am to 2.28 am (from 1.20 am Sun.).
CKCS 11.72 mc 7.30 am to 9.55 am.
CHOL 11.72 mc, 7.30 am to 9.55 am.

TO CARIBBEAN & LATIN AMERICA

CKRA 11.76 mc, 10.10 am to 11.0 pm.
CKCX 15.19 mc, 10.10 am to 11.0 pm.
CKCS 15.32 mc, 1.0 pm to 11.30 pm.

TO AUSTRALASIA—

CHOL 11.72 mc, 6.40 pm to 8.30 pm Sunday only).
CKLO 9.63 mc, 6.40 pm to 8.30 pm.
CKLX 15.09 mc, 2.20 pm to 3.0 pm Tues., Sat., for UN).
CHOL 11.72 mc, 2.20 pm to 3.0 pm Tues., Sat. for UN).

It will be noted that CKRP in the 3-metre band is no longer being used. In addition to the above International Service Canadian stations, the Halifax station CHNX on 6.13 mc can be heard most nights around 9.30 pm, while on a Saturday or Sunday afternoon, CBRX in Vancouver can be tuned in at fair strength till it leaves the air at 5.0 pm. Keep a lookout for CKRX in Winnipeg on 11.72 mc as we believe it will soon be on the air again.

NEW STATION LOGGINGS

Call	Kc	Metres	Location	Time Heard
NOUMEA	6035	49.71	Noumea, New Caledonia.	5.30 pm
DZ13	6110	49.10	Manila, Philippines.	9.00 pm
TGTO	6285	47.72	Guatemala City, Guatemala.	4.15 pm
EA9AA	7060	42.49	Tangier, Morocco.	6.30 am
APK	7140	42.02	Karachi, Pakistan.	10.00 pm
DAMASCUS	7145	41.99	Damascus, Syria.	6.30 am
OZU	7260	41.32	Copenhagen, Denmark.	6.30 am
KNBA	9515	31.53	Dixon, California, USA.	7.00 pm
KCBF	9700	30.93	Delano, California, USA.	7.00 pm
CR7	11765	25.50	Lourenco Marques, Mozambique,	11.30 pm
TANGIER	11790	25.45	Tangier, Morocco.	8.15 am
SAIGON	11840	25.34	Saigon, Indo-China.	9.00 pm
PRL5	11950	25.10	Rio de Janeiro, Brazil.	8.30 pm
KGEI	15105	19.86	San Francisco, Cal., USA.	6.30 pm
KCBA	15210	19.72	Delano, California, USA.	7.00 pm
KNBX	17830	16.83	Dixon, California, USA.	7.30 pm

NEW CALLS HEARD IN APRIL

PHILIPPINES.—Broadcasting in the Philippines seems to be extending all the time, as we have still another entirely new station which has apparently recently taken the air. Like so many others, it is located in the capital, Manila, and transmits on 6.11 mc with a surprisingly good signal.

They identify themselves as the Republic Broadcasting System, and on announcing give their call as "DZ double B on 580 kc and DZ13 on 6.11 mc." On some occasions they give their calls quite simply as DZBB and DZ3. We thought we might have received their verification in time for this month's issue, but, unfortunately, it has not yet arrived. No difficulty should be had in hearing this new one any night from around 8.0 pm.

GUATEMALA.—This Ceneral American country, though not very extensive in area, has certainly got quite a large number of radio sfations. Still another new one has recently been logged on Sunday afternoons till it leaves the air at 4.30 pm. The one in question is TGTO on 6.285 mc, which uses the title of "Radio Internacional." This station does not become audible until shortly after 4.0 pm in Sydney, when they are giving a musical programme.

Before closing at 4.30 pm they give a few chimes, which are very similar to the chimes from Big Ben before actually striking the hour. Although the call letters have not been heard in their announcement, their slogan, "Radio Internacional," can clearly be heard.

SYRIA.—There is great activity with the Damascus stations as they seem to have increased power recently together with carrying out experiments with different frequencies. A few weeks ago this station was heard at good strength every day till closing at 7.0 am using a frequency of 6.9 mc, but at the time of writing these notes they have made a move to 7.145 mc and remain on the air till after 7.0 am.

Their programme consists of musical numbers till around 6.45 am when they change over to a programme in Arabic, which continues till just after 7.0 am, when they announce in English, "This is the Syrian Broadcasting System, Damascus. The time is now 2300 hours." They then continue their transmission in French, but soon fade out completely.

INDO-CHINA.—For many years now we have been used to hearing Saigon operating on 11.78 mc, but, during the past year, they have been blotted out by New Zealand, which also uses this channel. A short time ago it was announced that Saigon was to move to 9.524 mc, but so far we have had no reports of them having used this outlet. They have made a change, however, and can now be found on 11.84 mc, where they announce as the Voice of France in the Orient.

Unfortunately this new channel is a poor choice as LRT overwhelms them from around 8.0 pm, and later DUH5 causes interference. It is reported from the States that they move back to 11.78 mc around 1.0 am, but we have not personally heard them at this time.

MOZAMBIQUE.—Our old friends, the Radio Club of Mozambique, delight in changing frequency and experimenting with new channels. Their latest movements seem to be concentrated on the 19 and 25-metre bands. They can be heard on a Friday morning only operating on 15.195 mc using the call-letters CR7BG, and are on the air from 6.0 am to 6.30 am. A more extended programme can be heard daily on 11.765 mc and the best time to log them is around 4.0 pm, although according to Art Cushen he hears them in NZ from as early as 2.0 pm and mentions a request programme at 3.0 pm.

We have no record of any call letters for this 25-metre band outlet, but, possibly, someone will be able to help before very long.

BRAZIL.—Another new station which Art Cushen told us about is PRL5 on 11.95 mc located in Rio de Janeiro. As is very often the case, reception in New Zealand is vastly superior to what it is in Eastern Australia, that is as far as the Latin Americans are concerned.

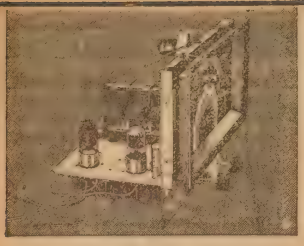
Although heard quite well by Art, the station is quite weak in Sydney, and it is only by careful listening it can be heard at all. When it first becomes audible around 8.15 pm, they are giving musical numbers and then from 8.30 pm to about 8.50 pm there is a news session in Spanish, followed by musical numbers till 9.0 pm, when interference becomes too bad for further reception. This station is operated by the Ministry of Education.

MISCELLANEOUS.—Quite a number of other new ones have shown up recently, among these being OZU on 7.26 mc, which is reasonably good until about 7.0 am when strength begins to fade. Programme consists of musical items and talks in Danish with chimes at 6.0 am; Radio Pakistan is on the move again and their latest channel is 7.14 mc, where they are heard at very good strength, giving the news in English at 10.0 pm.

Another changed frequency is Noumea, which has moved from 6.0 mc to 6.035 mc. They have a really fine signal when they come on the air at 5.30 pm, and we wonder if perhaps they have a new transmitter with an increase in power. Quality from this station is very fine, indeed, and a pleasure to listen to.

Radio Africa, on 7.06 mc, is strictly not a new station, as we seem to remember that Rex Gillett verified them some months ago, however we do not appear to have listed them as a new station. At the present time this station, which is located in Tangier, can be heard quite well from just after 6.0 am and is still audible at 7.0 am.

Another Tangier station, this time the new one operated by the Voice of America, is coming in very well on 11.79 mc around 8.0 am with English at 8.15 am. Finally we have a few new Americans, KGEI on 15,105 mc till closing at 6.45 pm, KNBA on 9.515 mc, KNBX on 17.83 mc, KCBF on 9.7 mc, and KCBA on 15.21 mc, all coming in at excellent strength nightly from 7.0 pm.



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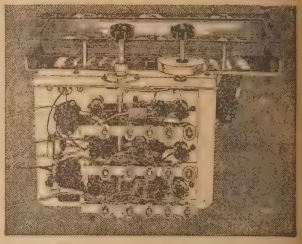

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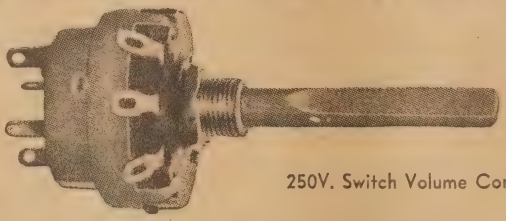

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THE HAM BANDS WITH BILL MOORE

With the western districts of NSW suffering the worst floods in their history, it is only to be expected that amateur radio stations would be rendering assistance to keep vital communication links open when formal circuits have failed due to flood damage

THE whole story of the work of the amateurs is not yet revealed, as some of them are still active in the devastated areas.

THE story from Wagga is fairly complete as the river there has returned to a reasonable level. Amateurs there were active in several spheres assisting the authorities and their work could be divided into two spheres—emergency communication, and supplying a link between the studios of the local broadcasting station and the transmitter site.

FLOODS AT WAGGA

On Thursday, March 23, the Murrumbidgee River at Wagga was at flood level and Alf Moye, VK2BW, reported to the local police that a portable and fixed station were available for assistance in maintaining communication if required. Earlier, DCA had installed a AT14 at the local police station and were in contact with the Army Depot at Bandianna and mobile units in the area.

At 4 am on the following morning VK2BW was called out by the Police Department and asked to co-operate. The main transmitter was then tuned to 5330 kc/s, the frequency in use, but for the moment VK2BW was engaged in receiving messages and obtaining further operators from about the town.

Later in the day the landline from the studios to transmitter of 2WG failed and VK2BW was requested by the authorities to use his station as a means of relaying the programme to the transmitting site some five miles away. A frequency of 7175 kc/s was used for this work.

Geoff Hodgson, VK2ASH, had already left for the transmitter with two short wave receivers to pick up the relay. His journey was an epic in itself, as most of the trip was made by hauling the boat along fences and the last portion on foot.

From 1 pm on March 28 the programme was transmitted via VK2BW. The local authorities were very concerned about the B/C station being on the air, as they considered that its operation was very necessary to keep the local population informed of the true emergency position. There were interference was encountered at times despite some good work by VK3KV and others. 2WG closed at 2015 hrs. and reopened at 0645 hrs. on the following day. The service ceased at 1715 hrs. when landline communication was restored by another route.

NARRANDERA

The superintendent of police then requested that communication be established with Narrandera, the next town likely to be affected by flood. The DCA's AT14 was taken from Wagga and installed there, and VK2BW's transmitter was substituted for it.

Traffic handling from Wagga concerned food orders and general working with the Army centre, North Wagga police station, where VK2AID's equipment was in use, aeradio station at Alstonville, and the radio-equipped "ducks" and vehicles.

Brian Mitchell was the day operator at the VK2BW equipment, and amateurs and DCA operators worked at night. The frequency in use was 5050 kc/s.

Mal Robinson, VK2HT, who was stationed at Wagga at the time, took 2BW's Type 3 Mark 2 to Darlington Point at the request of the police, and did a fine job relaying messages to the authorities at Narrandera.

During the crisis many amateurs co-operated, some in their official capacities. They included VK2AID, 2BW, 2ANT, 2ASH, 2HT, 2RB, ex 3BM, ex 3MX, ex 3KJ, and Maurice Harrison and Allan Williams, whose call signs are not known.

Alf Moye, VK2BW, and his wife were presented with an inscribed entree dish at the B/C station for the excellent work done, and due thanks were recorded publicly to the work of the radio amateurs.

At the time of writing, amateurs on the Macquarie and Lachlan rivers are still active on their emergency work, and when the full story unfolds due publicity will be given to their sterling efforts.

Emergency Nets

MOST divisions of the WIA have during recent months concentrated on their emergency nets and organisations.

The Queensland Division has arranged a State-wide network of over 50 stations and regular practices are held under the supervision of Frank Nolan, VK4FN.

The State has been divided in zones for emergency work and each zone is under the control of a zone captain. This officer is responsible for the collecting of messages from his own area and relaying them to the headquarters station VK4WI. During recent net trial runs, a mixture of telephony and Morse was used, but it was found that a separate frequency for each type of transmission was desirable. Several runs have been conducted and "dummy" messages from outlying stations have been relayed back to VK4WI.

In Victoria, the emergency net meets each Sunday at 1030 hrs. E.A.S.T. on 7002 kc/s. Arrangements are being made to continuously monitor this frequency, all transmitters and receivers are to be crystal locked. VK3LS is emergency controller for the Victorian Division.

Incidentally, the official emergency frequencies of 3501 and 7002 kc/s fall within the accepted CW sections of the band. During test runs it would be an advantage if CW stations could keep clear of the nets. It has been proposed by the Federal executive of the WIA that the recognised CW section of the 7 mc band be extended from 7000-7030 kc/s to 7050 kc/s, to allow uninterrupted net operation. The period during any month taken up by emergency net practices would only amount to a few hours, anyway.

Emergency net organisation in New South Wales varies somewhat from the other divisions as there is no State-wide net and areas most likely to suffer from the elements have their own separate groups. Two of these groups are being organised, one in the Hunter Valley and one on the North Coast.

The firstnamed has been in operation for some time and can now cover any emergency that is likely to arise. In the event of a breakdown in public communications, two stations, VK2ANU at Muswellbrook and VK2VU at Singleton, are in a position to record river heights; VK2TY can supply a link to the local broadcast station, while VK2XQ, VK2AKP and VK2ADX, in Maitland proper, would be able to supply communication in the city itself.

All these stations are fully equipped with portable battery operated transmitters and receivers.

Other stations in the Hunter Valley Emergency Network include VK2YO, 2AL, 2KZ, 2KF, 2AHA, 2ADT, 2YL, 2AFS, 2ZC. They will supply communication if required between the flooded area and other districts. They may also by-pass Maitland with traffic as was necessary during the last emergency.

Net practices are held each month and within the next few months all stations will be equipped with portable gear that can be moved to selected locations as required.

The Hunter Valley Net operates as a complete and separate unit and should be able to handle any communication problems that may arise. Emergency officer for the net is John Traill, VK2XQ, of West Maitland, while Vic Holmes, VK2AKP is his assistant.

John Brand, VK2ADX, city engineer for Maitland, has afforded valuable assistance in many ways, and aerials will be erected at the town and electricity supply stations in case of an emergency similar to last year.

Australian amateurs have in the past year become emergency conscious—their record during 1949 was an excellent one in the emergency field, and they are now generally making sure that in the future they will be even better equipped to carry out this type of work.

The UHF Bands

ANOTHER milestone in Australian UHF history was passed on Monday, March 27, when Bass Strait was bridged on the 144 mc band. For some months now Victorians and Tasmanians have been testing with portable equipment from elevated spots in an endeavor to make contact, but it was from home locations that the circuit was finally made.

Full credit must be given to VK3AKE, of Geelong, for the initial contact. A keen observer of conditions, on the day the opening was recorded, he wired the VK7's suggesting that they should listen out on 144 mc as conditions should be suitable. At 1945 hrs. E.A.S.T., his prophecy was fulfilled when he contacted VK7PF for an Australian 144 mc record of 285 miles, signals peaking at S9.

Later, VK3BW raised VK7MC and VK3AKE contacted two further Tasmanians, VK7BQ and VK7MC. VK3RK was heard by VK7MC and VK3ED by VK7RB.

At 0700 hrs. on the following morning VK3ABA was heard by VK7MC.

With so much activity on 144 mc, and the fact that some of the gang are running 32 elements, we should see some startling distances covered in the next few years.

Most of the 50 mc activity for the month has centred around extended ground wave work. Of special interest is the news from Dud Nourse, VK2DQ, of Broken Hill, a recent visitor to Sydney. He reports ground wave reception at Broken Hill of VK2JU of Sydney and VK2ADT of Cessnock on the 50 mc band. Dud identifies the path from the echo on the signal plus the lack of fading. Sydney stations are often audible on sporadic "E" reflections and could not be confused with extended ground wave signals.

Overseas News

COMMENT from both British and American sources leaves little doubt that the opening of the 21 mc Atlantic City band for amateurs is still a long way off. How long is quite uncertain, not this year anyway; perhaps during the early part of 1951 we may see the band in use.

The delay still centres around a group of officials in Geneva, who are endeavoring to iron out the many problems of frequency allocations below 27.5 mc/s. Quite radical changes were made over previous arrangements for the various services. The old Berne sys-

tem was abandoned and the committee sitting today is working on an engineered" allocation for every single one of the fixed, coastal, broadcasting and ground stations throughout the world. The original target date of May, 1949 set for the completion of the list was soon passed and to date the job is still not finished. It is hoped that it will, however, be completed shortly, and that during September a confirming meeting will be held to verify the arrangements and to decide on a date from which allocations below 27.5 mc/s. will become effective. The ARRL, for instance, is not optimistic that this schedule can be adhered to.

Just at the moment the 21 mc band wouldn't be much use to us due to the existing conditions, but maybe the next 12 months will see some improvement in the HF bands.

The next International Telecommunications Conference is listed to take place in Buenos Aires in 1952, so if the decisions are not final soon we may have further changes on our hands.

Of course, with the advent of 21 mc bands comes other changes in our 7 and 14 mc band widths, so some of the glitter will be taken from the arrival of a new band.

It would appear that after prolonged negotiations covering a year, the proposed changes in amateur radio regulations in the US have been finalised.

The majority of the recommendations of the ARRL presented at a conference with the FCC have been incorporated in the final draft. The ARRL board, on behalf of the American amateur, is still strongly opposed to two sections, as mentioned later.

The licence classes and qualifications required are:—Amateur Extra Class: 20 WPM code requirement and an advanced technical examination (this class allows all amateur facilities). Advanced Class, General Class and Conditional Class: 13 WPM code and technical examination.

Technical and Novice Classes: Requirement for code 5 WPM, plus a technical examination.

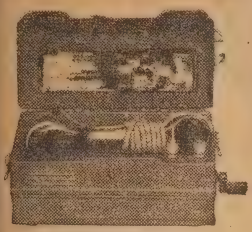
Operation under the last two classes is very limited. The technical class licensee can only operate on bands above 220 mc/s, while in the novice class operation is restricted within 3700-3750 kc/s, 26960-27230 kc/s, and 145-147 mc/s.

Other general items of interest include the fact that licences will only be renewed if the applicant can show he has been active for a period of two hours in the last three months or five hours in the last year. The applicant must also sign a statement that he can send and receive Morse code at a speed not less than his original licence requirement.

The novice class licence expires at the end of the year and is not renewable. Other licences carry on for five years.

The ARRL Board objects very strongly to the proposed amateur extra class for several reasons. Firstly, that after 1951 applicants for 3.5 and 14 mc telephone privileges will be required to pass a code test of 20 WPM, a requirement not in line with telephony operation, and secondly, that in the future licensees will be granted additional privileges. The board feels that if any allowances are to be made in the future the whole licence position be reviewed.

Exception is also taken to the general terms of operation under which the FCC proposes to direct the channels along which amateur radio will develop. The board considers that the future growth of the hobby should be untrammelled as in the past and that unrestricted growth is the most important factor for a strong and healthy amateur radio.



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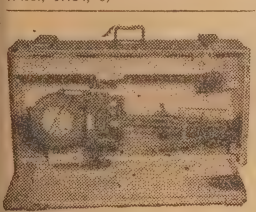

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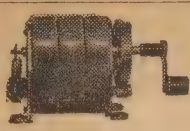

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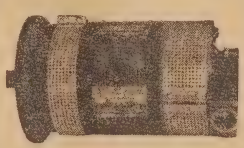

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OFF THE RECORD — NEWS & REVIEWS

Correspondence, as most of our readers will by this time be aware, is a most fruitful source of ideas, not only concerning records, but of other things as well. This month I have one or two points of more than usual interest.

By JOHN MOYLE

ONE reader puts a problem which arises from a number of statements made in articles dealing with high fidelity equipment. I stress this point because in the term "high fidelity" really lies the key to what he has to say.

Briefly this man has a friend who no doubt is typical of many record enthusiasts. He has a speaker of the normal 12 inch type which, my correspondent is aware, has far from even response over its range. The speaker dies away below about 70 cycles, has a characteristic rise in the region of 3-4 kc., and rapid attenuation over about 6 kc.

His pick-up, on the other hand, is of a type which has a marked resonance about 9 kc.

The letter continues — "Despite your condemnation of peaks in pick-ups as producing poor results, my friend's set is very pleasant to listen to, and seems to have a very good high frequency response, if high violins and jingles have anything to do with it. Frankly I am puzzled why this should be, as I can see the logic in your remarks about trying for flat response in all parts of the radio gramophone."

Now I must admit that I have already given a clue to the answer by the way I have posed his question.

Although I have convinced myself of the wisdom in trying for flat characteristics everywhere, it must be borne in mind that, within reason, it is quite possible for a component somewhere along the line to have a deficiency in one section of the spectrum which can be wholly or partially made up should a peak appear at the same spot in another.

COMPENSATION

After all, it is the sound which ultimately comes from the speaker which assails our ear. We do in fact, make use of the principle stated above every time we compensate for a peak in a pick-up, for instance, by inserting a carefully designed circuit which introduced a "dip" or absorption effect at the same frequency as the peak, and of about the same amplitude.

You will remember this practice being followed in certain pick-up design circuits mentioned recently, where exactly this procedure was adopted.

The speaker in question, it is admitted, has a rather sharp tail off after about 6 kc. and at 9 kc. it's response will be well down the decibel scale. If however, we use such a speaker with a pick-up which, as in this case, has a pronounced resonance at 9 kc., it will tend to lift the response in this region, and probably somewhat before it. If we knew the speaker was 10 db down at 9 kc. to quote an imaginary figure, and the pick-up has a resonance peak of 9 db, we would not be conscious of any serious deficiency at this frequency when listening.

If by some chance the speaker died away at the same rate as the pick-up output began to rise, the net result would favor a flat response to 9 kc.

HIGHS EMPHASISED

Unfortunately, however, it is most unlikely that such perfect cancellation would ever occur. It is much more probable that the speaker will die away more rapidly than the pick-up could rise. As a result, we will get a pronounced "trough" between the 6 kc. and the 9 kc. points, with the 9 kc. peak being too small to bring the output up to reference. The rise, however, is often enough to re-inforce the top end at this point sufficiently to preserve a good proportion of 9 kc. reponse, and, in fact, to emphasise what it does produce because of the trough which occurs immediately before it.

As my correspondent has observed, ıe total effect is too often quite a easant one, when regarded purely the light of frequency response. The distortion introduced at re- ted frequencies lower than the ak will, of course, still be there, d will add their little bit in spoil- g the cleanness of the response as whole.

Our ears, however, are rather ac- mmodating devices. When playing chestral music, for instance, here complicated waveforms are volved, we often learn too accept tite cheerfully a reduced standard quality until we have a chance compare with a better system, or hear such a system long enough our ears to appreciate the dif- rence.

On difficult vocal records, how- er, a certain amount of distortion ill probably be present unless the eaker has a cut-off low and sharp ough to act as an automatic "top t filter" which is effective all the me.

CCIDENTAL DESIGN

As my correspondent has noticed, is possible to have quite pleasant sults from a combination of med- m grade components, which, as I ve shown, are due to accidents of sign and combination in which e defects in one component are rtially compensated by what are ally defects in another.

I would point out quite definitely, wever, that there would be a ticeable difference between such set-up and a really good one if ey were played side by side. My marks about "flat" amplifiers ply with their full force only to gh grade equipment, where we are iving for a standard too high for t but the best recordings. As I ve stressed all along, it is only th such records that the full ad- ntages of high quality equipment, n be realised.

Almost every correspondent has use sooner or later to lament the arth of good gramophone motors a reasonable price. There is un- rtunately, nothing much to be ne about this state of affairs ex- pt to see that the motors we do use are well mounted and looked after.

One common practice which doesn't do motors any good applies to the rim-drive type, of which there are many examples to be found these days.

These motors invariably drive the turntable by means of a rubber ring mounted on the motor shaft, and are held by spring pressure in contact with the turntable.

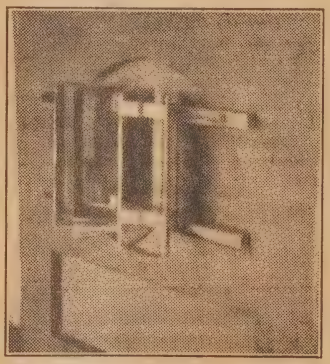
It is most important with such motors that the rubber should not be left in contact with the turntable rim when the motor is not in use.

If this is done, the sustained pressure on one spot will sooner or later produce "flats" on the rubber, and the motor will not run evenly because of them. This point is well stressed by the manufacturers, who in I should say every case provide a means of disengaging the rubber ring when the motor is idle.

This isn't just an idea on their part, or a point which can be safely ignored. It is most important, and sooner or later you will have trouble with your motor unless you are careful to follow their instructions.

HIGH NOTE DIFFUSION

Another reader writes to tell me, with two photographs, of a set of diffusing vanes he has attached to his vented enclosure to disperse the high frequency radiation from the loud speaker.



The high-note diffuser as used by one of our correspondents. Some enthusiasts may prefer to merge the vanes with special styling of the cabinet or speaker enclosure.

The speaker is an Axiom 12, which has a small, high frequency cone attached to the main cone, and which has a very high frequency response. As with almost any such speaker, however, the highs tend to radiate in a more or less sharply defined beam so that only when directly in front of the speaker is the full effect of the high notes obtained.

The use of three or four vanes—in this case about 9 x 6 inches—arranged to disperse the high frequency radiation, is quite effective. If they were enclosed top and bottom, we would have an elementary form of cellular horn something like that used on many imported high quality speakers. This treatment however, is only necessary for tweeters.

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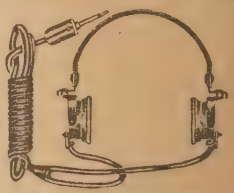

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JET POWER FOR MODEL PLANES

(Continued from Page 81)

le person; and do not forget, one is ıling with a lot of power which lds up, due to ram effect.

Several experiments have recently en made with a gas-turbine for del work, and I am therefore illus-ting the principle in Fig. 3. It is y a matter of time before we have bo-jets like miniatures of the most ıal full-size jet engine commer-lly obtainable. The gas-turbine ıws its own air supply by a com-ssor (fan) at the front of the tor. The air is mixed with fuel and mixture burns and expands in or more flame tubes.

The resulting gases drive a turbine the rear of the engine. This tur-e is mounted on a shaft with the mpressor at the other end, so that turbine drives the compressor, ich in turn provides the air for nbustion. It is quite a simple basic nciple, but requires some care in ign and careful selection of metals stand up to the high operating tem-ratures. It may interest readers to ır that the exhaust gases emerge m the tail end of a full-size gas-bine at over 1000 mph.

CKET MOTORS

Ve have so far discussed the non-ket type of motor. However, there an extraordinarily useful little tor on the British market using d fuel. This is a controlled rocket e.

)ne has come to associate the ket with a dangerous instrument ing off a huge burst of power and nes and smoke subsiding to noth-quickly. The Jetex engine has of these bad features. The solid burns with a constant and equal ust, and is quite safe.

These little motors are made in ee sizes and all come into the small del class.

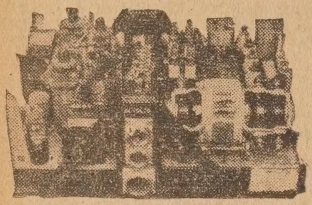
etex engines have a light alloy inder or combustion chamber, into ich the solid fuel charge is in-ted. A wick is then lighted, and the burning gas expands it escapes m the jet orifice with a pleasant s and a realistic trail of white)or is left behind the model. Fast dels are best for these engines.

At the filling end there are three or re springs which retain the filling) and act as a safety device should jet orifice become blocked by an ikely mischance.

Any boy can operate a Jetex en-e in safety, and all he has to re-mber is not to take hold of the her hot motor immediately after a ht. They do not glow red like the ge pulse-jet engines we have dis-ssed, but they are too hot to the ich.

Satellite rockets whirling around e earth at an altitude of 4000 les may some day broadcast tele-ion images of cloud movements. is information would enable very curate weather reports to be med.

RADIO PARTS! RADIO PARTS!



TR1196A TRANCEIVERS

This transceiver is suitable for bush fire brigade work, etc. Has output of 7 watts built in generator to work off 12 volt D.C. supply.

Receiver Transmitter and Power supply are all separate units which plug in and make a complete assembly. Receiver uses six valves:

2—VR53 1—VR55
2—VR56 1—VR57.

Transmitter uses.

1—VT501 1—VT52 1—VR91.

Each transceiver equipped with all valves and in good condition, but less crystals.

Both receiver and transmitter operate on any one of four channels. Price only .. **£7/15/-**

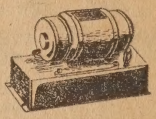
NOTICE:

All parcels will be sent registered post unless otherwise stated. Postage must be included with all orders.

PORTABLE CABINETS

Made by Cadet Radio. This cabinet suitable for job portable chassis sold by us some time ago. Can also be used for extension speaker cabinet, etc. Will house 8-inch speaker.

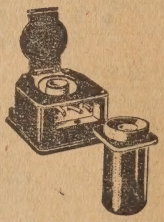
Price for body and cabinet only, without back or lid as illustrated—not covered with leatherette 5/6
Covered with leatherette .. 10/6
Lid partly complete — not covered 1/6
Piece of ply suitable for back —not covered 1/-
Dial Glass to suit 3/6



GENERATORS

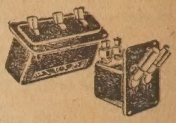
F.W.D. Genemotors suitable for amplifiers, etc. Input 26 volt D.C. Output 340 volt D.C. at 215 m.a. An excellent heavy duty job with filter circuit.

Price only **£4/10/-**



PUSH BUTTONS

Type illustrated with cover is a S.P.D.T. Type used in aircraft bombing circuits. Price only 2/-
D.P.S.T. Push Button also illustrated, suitable for Bell Push, Motor Horns, etc. Price only 1/6
S.P. Type to fit in wire for use in photography, etc. Price 1/6



SWITCHES

Aircraft Two - way Ignition Switches as illustrated. A very sturdy and reliable switch.

Price only 2/-

Triple Toggle Switches as illustrated. Housed in solid bakelite case. Nickelplated toggles.

Price only 2/9

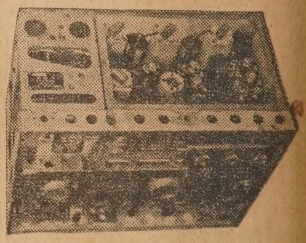
Single Toggle Switches similar to above. Price 1/6

Cuttler Hammer type Toggle Switches as used in aircraft bombing panels available in SPST and SPDT. Price 1/6

Cuttler Hammer type Double Pole Toggle Switches available in DPST and DPDT. Price only 2/6

MICRO SWITCHES

In perfect condition. Price new 17/6. Our Price 6/6



TRANSMITTER RECEIVER

Type TR1143. The English equivalent of the SCR522.

Valves Used.

4—EF50
16—Octal base H.F. Rentodes such as VT50, VR53.

Each set is equipped with valves but less crystals and in good order and condition.

A real bargain for **£10/10/-**

Motor Spares Ltd

547 ELIZABETH STREET, MELBOURNE

C.H. (Invercargill, NZ) sends in a smitter and a receiver circuit for ment in the pages of Radio and bies. He also asks whether a magic tuning indicator is of value in a munications receiver and also if we e ever described a V.F.O. for use with iteur transmitters.

Thanks for the circuits, G.C.H., we review them as soon as possible. A gic eye would be quite helpful with eceiver of the type mentioned. How-r, it is not nearly so valuable as an meter. We have not, to date, de-bed a V.F.O. and have no imme-e plans for describing one. Thank for the nice remarks about Radio Hobbies.

.G.M., Toowoomba, Qld., asks if we e ever described the construction an acoustic mandolin as apart from tric guitars.

o, R.G.M., we have never described acoustic instrument and think that must have seen the article in ther publication. The only musical ruments described have been electric tars.

.W.D., Hamilton, NZ, says that he is ased with the performance of the iper Tuner" and the "Senior Portable." portable, he says, performs better n most of the commercial types he seen in NZ. He also asks when we going to describe a radio-controlled tem for model aeroplanes.

hanks for the letter, R.W.D., and we re pleased to hear of your success th the portable and the tuner. Un-tunately, we have not been able to anything to date with the radio-control tems and we do not see our way clear remedy this in the near future. The erest in this type of equipment is y limited and at the moment, we do feel that the large amount of time uired to develop a remote control tem would be justified.

SEVERAL readers have written in asking for the base connections for the CRI39 Cathode Ray Tube. To satisfy his demand we are printing them below. The pins are numbered clockwise when looking onto the back of the valve and the numbers commence on the left hand side of the locating keyway.

Pin 1. Cathode, pin 2. grid, pin 3 & 4 heater, pin 5 anode No 2, pin 6 blank pin 7. deflector Y2, pin 8 deflector X2 pin 9 anodes 1, 3 & 4, pin deflector X1, pin 11 deflector Y1, pin 12 blank.

In this tube anodes 1, 3 & 4 are the high voltage anode and anode 2 is the focusing anode.

R.D., Prahran, Vic., suggests that it's out time we described a set to replace e "4-48" receiver. He suggests that e set could use all miniature valves d a dial such as used on the "Karset." Thanks for the letter, R.D., we have immediate plans for a set such as you ggest but we do intend to describe set of this type in the not too distant ture.

R.R.D., Wellington, NZ, says he enjoys ading R. & H. and thinks it is an ex-llent magazine. He also sends in the rcuit of a two-valve battery set which thinks may be of interest.

Thanks for the kind remarks, R.R.D., e are pleased to hear of yet another ew Zealander who enjoys R. & H. ctually, we did describe a set some-hat similar to the circuit in the April 40 issue of R. & H. The main reason e do not describe sets of this type ow is because 1D8—GT valves are some-hat scarce in this country. However, e may be able to feature your circuit the "A Reader Built It" page of R. & H. the near future.

P.D., Romsey, Vic., asks if we have any mple books on radio. No, P.D., we not stock actual books of this kind r have we any reprints of beginners' ticles which have appeared in R. & H. e can only suggest that you try to t some back copies of R. & H., starting ith the April 1949 issue. In these sues there appeared a series of articles r the beginner which would be very lpful to you. A good elementary text book is An Elementary Wireless Course for Beginners, by Reyner, which is available at all leading bookstalls.

C.S.S., Maleny, Qld., sends in a twelve-months subscription to Radio and Hobbies and also asks us to recommend a suitable book for a beginner.

Thanks for the subscription, C.S.S., it has been passed on to the appropriate department and they, no doubt, have communicated directly with you by now. As to the book we can recommend An Elementary Wireless Course for Beginners, by Reyner, which is available from all good bookstalls and also suggest that you try to obtain some back issues of R. & H., commencing with April 1949. In this and the following issues there appeared a series of articles on interpreting circuit diagrams.

Wanted to Buy, Sell or Exchange

FOR SALE: Mobile Aerial Bases, 1 Amer. Disc Recorder and Playback, Various Meters, Conds., (Splitstator, Mica, and Paper) Telescopic Drawer Slides and large quantity of Radio Parts Cheap. Write or call **170 Dunning Ave., Rosebery.**

FOR SALE: Cardwell Crystal Frequency Meter, 200kc—20 megs. Best offer. **100 Mowbray Road, Willoughby, N.S.W. XL2610.**

FOR SALE: Garrard Model V Radiogram Unit, less pickup, £4/15/-. **4 Younger Avenue, Earlwood, N.S.W. LL3686.**

FOR SALE: Amplifier — commercial 13 watt. Vibrex recording unit with playback. Shure microphone, model 55, multi-impedence. All hardly used. What offers? **J. Heffernan, 64 Buckley St., Essendon, Vic. FU2335.**

FOR SALE: A.C. operated BC348 receiver and BC221 frequency meter in excellent condition. Offers to **Corcoran, Edge St., Murarrie, Queensland.**

FOR SALE: Radio spare parts and oddments, new and used. Cheap. **UF2510 after 6 p.m.**

SALE: One University Supertester model, T.S.T., almost new. £25 or offer. **S. J. Spriggs, 202 Church St., Glen Innes, N.S.W.**

SALE: American General Radio Signal Generator. Model 601-A Output Meter. Range 140-1600 K.C. £7. **XL3373.**

Readers wishing to buy, sell or exchange goods are invited to insert an advertisement on this page. The cost is 1/6 per line; approximately 5 words to a line. Advertisements for the next issue must reach our office by NOON WEDNESDAY, May 10, 1950. Dealers' Advertisements not accepted.

SALE: Experimenters' panel mounted multimeter, A.C., D.C. volts; ohms; Mills. Visual-aural Signal Tracer, Bridge Circuit, VTVM to 5000 volts, A.C.-D.C.; R.C. Bridge; other portable instruments. Worth over £100. First nearest £60 secures. **Phone FY3636, Sydney.**

SALE: New guaranteed Disposal Valves, 813, 815, 213, miniatures, etc., cheap. Prices, 813, 815 from £2. Small tubes from 12/-. **Johansen, 263, Stoney Creek Rd., Kingsgrove.**

SALE: 1950 9v. Hallicrafter S40 A.U., 540 K.C., PO 43m.c.; Band spread B.F.O., A.N.L., etc. New. Best offer. **N. C. Wilson, 161 Fox Valley Road Wahroonga, N.S.W. JW1955.**

SELL: Tom Thumb (1T4, 3S4, excel. performer, low batt. drain on Multi-Talkie chassis, high polished cedar cabinet. £6/10/-. **R. Toming, 190 Prince's Highway, Arncliffe.**

SELL: No. 19 Valves Control Box Power Supply 12v. Battery in rack with 4-valve TX. £20. **UX7272, Sydney.**

SELL: Crossley TX.RX 3.7-5.8 m.c., £5. Receiver, 6 tubes, plug-in formers, 40m. coils, £15. Transformer, 1500v. C.T., 150 m.a., 1200v. 30 m.a., three rectifiers, £3/10/-. **VK2GC, Mosman. XM3910.**

SELL: BC348 Communication Receiver, perfect order. Power pack and speaker. **68 George St., Dover Heights.**

SELL: 2JU5 amateur wireless, also 5BP1 CRT. Numerous other radio parts. **257 Riley Street, City.**

SELL: Phillips R163 Communications Receiver. Broadcast to 21 megs. **32 Homebush Rd., Strathfield. UM6349.**

SELL: 2 rotary beam direction indicating systems, fine appearance, solid ultra-modern radiogram cabinet, pair new 801's; ham sundries. **Ayre, 7 Kenmare Street, Mont Albert, E.12, Vic.**

SELL: Best offer Popular Mechanics, June 1944 to December 1949. 8 copies missing. **E. James, Strathmerton, Vic.**

SELL: Kingsley Portable Wireless, shoulder strap type. Perfect order. Best offer. **R. Hambling, 88 Bayview St., Williamstown, Melb.**

SELL: Cast Brass 12in Turntable, 14lb. All surfaces machined, sturdy bearings, runs dead true. Offer. **D. Rutledge, 30 Mullum Rd., Ringwood, Melbourne.**

SELL: Hi-fi Speakers, Goodman Axiom 12, £12; Ferranti M1 Super, £2; Pick-ups, Lexington, with transf., sapphires, £6; Audak, £7; Console cabinet, £1/10/-. **10 Lamette St., Chatswood, Sydney. JA8647.**

SELL: 2v. rec. (108-1P5) less batteries, phone, £4/10/-; xtal set, 10/-; 2 new "H" 2 gangs, 7/6 ea.; new valves, 1R5, 1J6, 1C7, 1D5-GP used; 32, 34, 49, 5/- ea.; 3 audio trans., 2/6 ea.; 2 power trans., 10/-, or £9 lot. What offers? **Underwood, Bulby Brush, Via Kraibach.**

SELL: MK2 Type 3 Transceiver, complete with valves. Modified phone work. Best offer. **D. A. Wise, Cape Clear, Vic.**

EXCHANGE: Radio & Hobbies Set, Valve Vibrator Radio, in floor case, net, for a 32-volt 16mm movie projector without sound. **L. C. Munchow, Bongeen, via Oakey, Qld.**

EXCHANGE: Send 5/- and 6 ties you are tired of to Box 40, George St Nth. P.O., and you will receive 6 other different "like new" ties expertly dry cleaned.

WANTED: Following issues of Radio and Hobbies, 1946: January, February and September. 1947: February, March, June, August, September and November. **R. A. Sutherland, P.O. Rabaul, New Britain.**

WANTED: R & H, Vol. 2, No 3; Vol. 3, No. 1; Vol. 8, No. 5, 9, 12. Valves KK2, KF3, KBC1, KL4. New or in good order. Sell about 50 copies R & H, Vols. 1-7. **J. Fensom, Hillston, N.S.W.**

WANTED: Copies Q.S.T., June '47; C.Q., Sept., Oct. & Nov., 1948. Good condition. Price to **Loveday, Elimbah Q.**

WANTED TO BUY: BC453 Command Receiver and BC221 Frequency Meter. **G. Laver, Fish Creek, Vic.**

WANTED TO BUY: A.R.7. Receiver, type 3MK, II, R.C.16.B., A.T.R.4, F.S.6 or type A. MK III Transceivers. **Laver, Fish Creek, Vic.**